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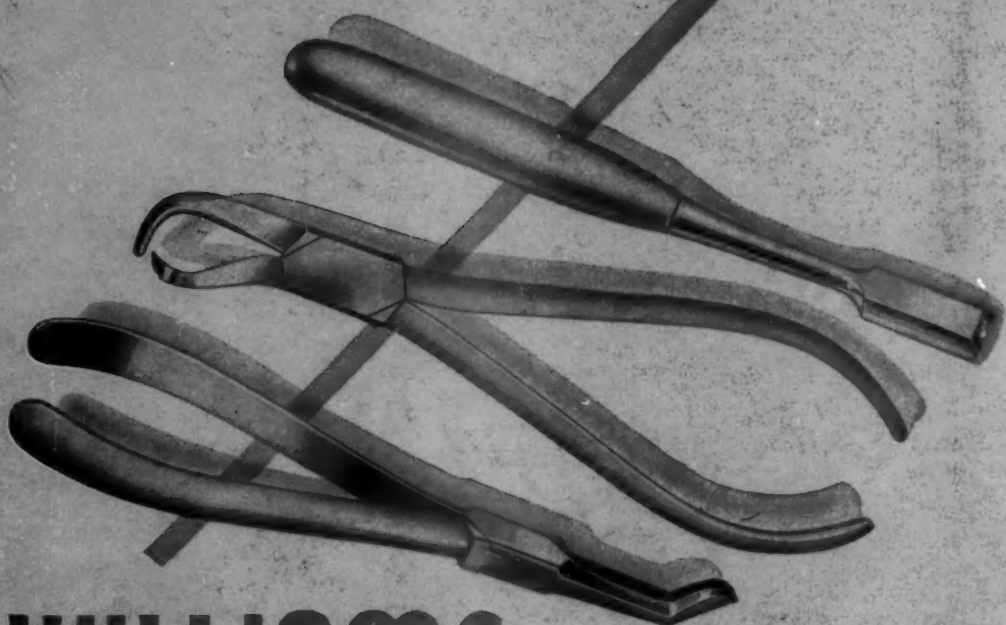
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VOL. 40

JANUARY, 1954

No. 1

**Original Articles**

**A CRITICAL REVIEW OF CLINICAL CEPHALOMETRIC RADIOGRAPHY**

T. M. GRABER, D.D.S., M.S.D., PH.D.,\* CHICAGO, ILL.

THE present high level of appliance construction and comparative efficiency of tooth movement have only accentuated the diversity between treatment objectives and treatment results. In our search for a single appliance that will manage all malocclusions, the trend has been strongly toward more and more control of individual teeth. The pendulum has swung all the way. The resulting complexity of appliances, while solving many problems of mechanotherapy, especially in Class I cases, has introduced new and more far-reaching problems and has pointed up the inadequacies of conventional Class II therapy. The controversy over extraction in orthodontic treatment has not been resolved. The increasing recognition of the role played by growth and development and of the limitations of each case is the inevitable result of an era of overmechanization, but there is no easy answer, no prognostic panacea. Let us not expect that cephalometrics will provide all the answers. Used properly, recognizing the limitations imposed by biometrics, the therapeutic road ahead can be made a good deal smoother.

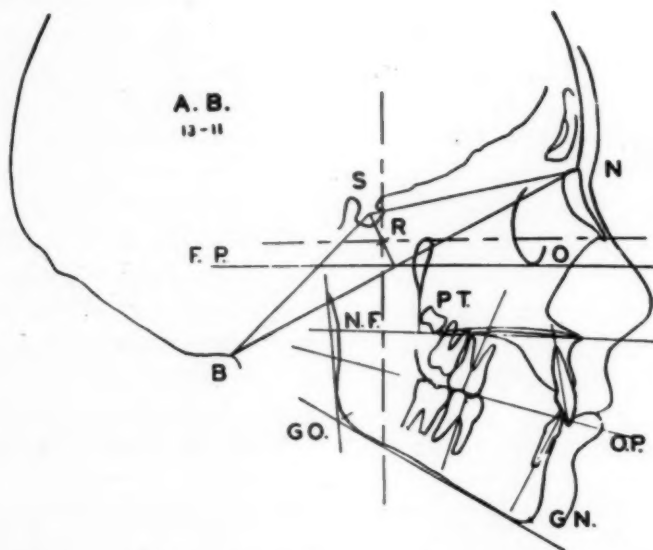
Cephalometrics, per se, is not new. Ever since Camper investigated prognathism craniometrically in 1791, anthropologists have been interested in the ethnographic determination of facial form and pattern.<sup>1</sup> Hellman made use of a rich experience in anthropology to study growth and development and to apply his findings to clinical orthodontics.<sup>2</sup> Like so many investigators, Hellman was searching for the so-called "normal" in his anthropologic cephalometrics. He lumped together skeletal material of unknown history and dubious ethnic origins, and developed his normal standard in a cross-sectional manner. Despite the obvious limitations of Hellman's approach, it is a tribute to his astute interpretation of his material that what we know about the mechanism of cranial and facial growth today does not significantly differ from Hellman's observations on dried skulls.

Simon's recognition of the contributions and limitations of anthropometrics permitted him to develop gnathostatics as a diagnostic medium, relating

Read before the American Association of Orthodontists, Dallas, Texas, in April, 1953.

\*Associate Professor, Department of Orthodontics, Northwestern University.

With the introduction in 1931 of the Broadbent-Bolton cephalometer which incorporated a radiographic approach eliminating the inaccuracies of Simon's soft tissue landmarks, developmental changes could be followed longitudinally in the same individual.<sup>4</sup> The unfolding of the developmental pattern and the strong adherence to hereditary predetermination have been repeatedly explored and clarified by Broadbent and many others.<sup>5-8</sup> The importance of this aspect of cephalometrics is a subject in itself and cannot be overemphasized.<sup>9-10</sup> For the development of the clinical phase of cephalometrics, however, we must turn to the contributions of Brodie, Downs, Higley, Margolis, Mayne, Riedel, Thompson, Tweed and many others to complete the mosaic of cephalometric diagnosis.



Early interpretations of lateral headplates were general in nature. Brodie and his associates published a cephalometric appraisal of orthodontic results in 1938 (Fig. 1).<sup>11</sup> From this preliminary report, it was pointed out that intermaxillary elastics changed the occlusal plane and inclination of teeth, but that there was a strong tendency for a return to the original inclination after treatment. Tooth movement, per se, was assigned a lesser role, with growth and developmental changes assisting apparent changes in occlusion. Changes induced by tooth movement appeared to be confined to the alveolar process.

Higley, in 1940, showed the advantages of obtaining hard and soft tissues simultaneously, and implied that the gonial or mandibular angle might be considered in treatment planning.<sup>12</sup> As Higley pointed out, observation alone is

not sufficient to determine the nature of the therapeutic result. Certainly this is just as much a challenge to the clinician today.

In 1940, Margolis re-emphasized the importance of recording changes by means of cephalometrics (Fig. 2).<sup>13</sup> He superposed his headplate tracings, using the occipitosphenoidal suture as a posterior terminus of a cranial base plane.

The last decade has seen the introduction of a number of cephalometric analyses, geared toward determining facial pattern, that point out dental abnormalities and predict treatment aims, aids, and limitations. It is the purpose of the rest of this article to discuss some of these approaches, pointing out

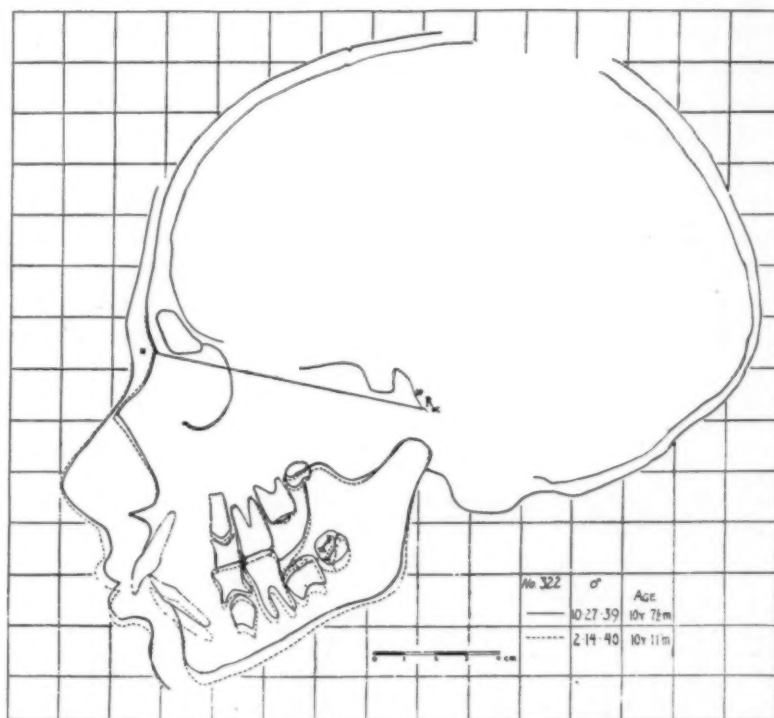


Fig. 2.—Superimposed cephalometric tracings by Margolis. Note the use of sphenoccipital synchondrosis as a posterior terminus to the cranial base. Profile faces left, instead of right as established by anthropologic tradition and followed in other cephalometric techniques. (From Margolis: *AM. J. ORTHODONTICS AND ORAL SURG.*, August, 1940.)

their similarities, complexities, strong points, and weaknesses. The selection of the several approaches does not ignore the possible existence of other equally valuable techniques. The scope of the study and the emphasis on clinical practicability have been the determining factors. The order of discussion has not necessarily been dictated by prior introduction of a particular technique to the field.

There is no doubt that the initial use of cephalometric radiographs as diagnostic criteria had an institutional character. Cephalometrics was rightly a research tool. Mayne's work in 1946, exploring the many possible correlations of craniofacial and dentofacial components, is a good illustration (Fig.

3).<sup>14</sup> Major emphasis was placed on angular relationships, rather than on linear measurements, because of the magnification of the film image. Other cephalometric endeavors were bent toward substantiating existing clinical hypotheses. Most notable of these have been the inclination of the mandibular incisors and the Frankfort-mandibular plane angle. Margolis, Rushing, Sims, Speidel, Noyes, and others produced cephalometric evidence from cross-sectional studies, apparently corroborating Tweed's clinical observation on the

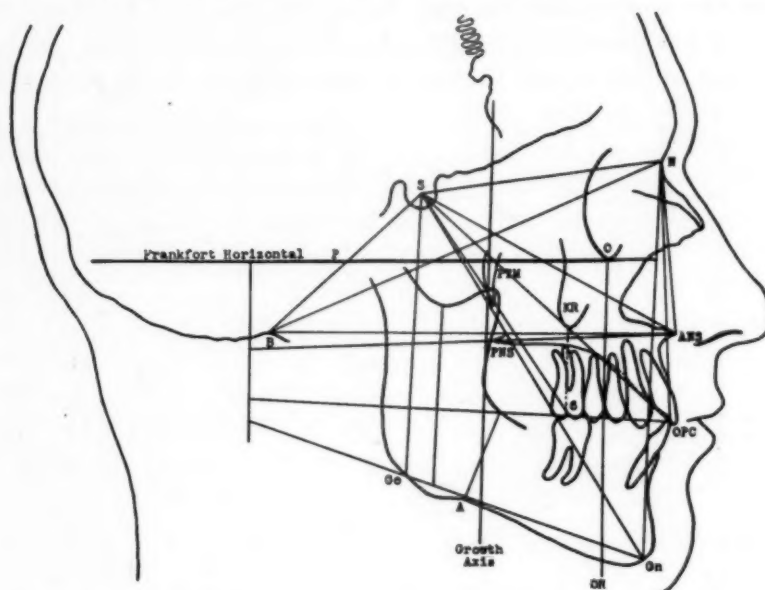


Fig. 3.—Cephalometric tracing of an individual with clinically excellent occlusion, showing criteria used by Mayne in his study of "normal" adults.

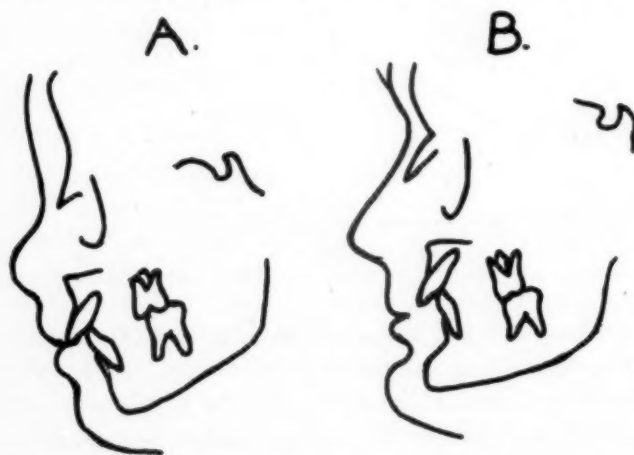


Fig. 4.—Cephalometric tracings, after Higley, showing broad morphologic variance of mandible in Class II malocclusions. Note particularly the outline of the symphysis and its influence on the profile.

erectness of the lower incisors over the mandibular base.<sup>15-17</sup> Simon had noted that the mandibular plane angulation was a valid diagnostic criterion for the severity of Class II malocclusions. Subsequent cephalometric studies on cross-

sectional groups of patients with Class II malocclusions seemed to verify the gnathostatic use of the Frankfort-mandibular plane angle as a diagnostic criterion. In 1945, Higley showed the high degree of individual variation of mandibular size and shape in Class II malocclusions (Fig. 4).<sup>18</sup> Mayne corroborated this with his study of fifty individuals with clinically excellent occlusions. He showed the broad range of variability of all cranial and facial relations from individual to individual. In 1946, Tweed re-emphasized the importance of the Frankfort-mandibular plane angle in orthodontic diagnosis.<sup>19</sup> He observed that the steeper the plane, the poorer the prognosis.

Wendell Wylie wrote in 1947, "Among the students of human cranio-facial morphology, many of whom are orthodontists, there is a growing conviction that there is no such single entity as a 'normal' facial pattern, and that the dento-facial anomalies are in a large measure occasioned by a random combination of facial parts, no one of which is abnormal in size, when taken by itself, but each one of which may fit badly with the other parts to produce a condition which may be called dysplasia."<sup>20</sup> Wylie pointed out that among the variations to be considered was the length of the cranial base between the glenoid fossa of the temporal bone and sella turcica, the over-all length of the maxilla, the position of the maxillary permanent first molar, and the over-all length of the mandible (Fig. 5). He used these criteria in an attempt to assess anteroposterior dysplasia and determine the crux of the malrelationship.

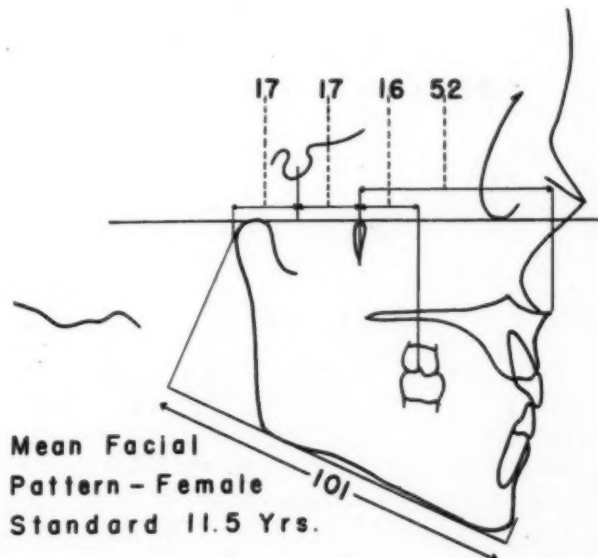


Fig. 5.—Study of Class I malocclusions to assess anteroposterior dysplasia. Measurements are made to determine size and position of maxilla and mandible in relation to the cranial base. (From Wylie: *Angle Orthodontist*, 1947.)

"Standard values" were developed from a comparison of Class I and Class II malocclusions. If measurements were greater than standard for the glenoid fossa-sella turcica length, sella-ptyergomaxillary fissure length, total maxillary length, and pterygomaxillary fissure-upper first molar length, the face would

be more orthognathic (or retrognathic), with a greater likelihood of a Class II tendency. This would be coupled with a shortened mandibular length. The opposite trend, with readings less than standard for the first four, and more than standard for the last, would make the face more prognathic, or more of a Class III type. Since one factor might cancel out the other, the net score is used by Wylie in determining the units of anteroposterior dysplasia. A severe Class II malocclusion would tend to show the condyle further posterior (Fig. 6, Item 1), the posterior terminus of the maxilla further anterior (Item 2), the entire maxillary length greater (Item 3), the permanent first molar further forward (Item 4), and the mandibular length shorter than standard (Item 5). Seldom in actual practice would this orthognathism be total. Wylie cautions that this approach is primarily to assess basal craniofacial morphology, and that only one of the measurements (pterygomaxillary fissure to permanent first molar) is susceptible to orthodontic treatment.

In 1947, Margolis published his approach to cephalometric diagnosis, based on thirty skulls and 100 children, 6 to 19 years of age.<sup>15</sup> He introduced the maxillofacial triangle, constructed on a standardized sagittal or lateral head-plate (Fig. 7). The three sides are the cranial base line (N-X, from nasion posteriorly through the spheno-occipital synchondrosis), the facial line N-M (in reality, this should be N-P, since the most anterior point on the symphysis of the chin is pogonion, not menton), and the mandibular line M-X. Margolis felt that the characteristics of the maxillofacial triangle were sufficiently narrow to establish a basic pattern. He noted that the facial line intersected the lingual surface of the crown of the mandibular incisor, but that the mandibular incisor could be lingual with an exaggerated mental eminence, or when the incisors are inclined lingually. Margolis also pointed out that the incisor mandibular plane angle was 90 degrees, plus or minus 3 degrees.

In 1948, Downs introduced his work on variations in facial relationships. He pointed out their significance in prognosis and treatment. Downs' analysis is the result of three years of experience with the method in practice and in the orthodontic departments of the University of Illinois, University of California, Northwestern University, and University of Indiana. A total of ten figures are used in the appraisal to describe the skeletal and denture relationships, based on a study of twenty living individuals with clinically excellent occlusion, ranging in age from 12 to 17 years. Because of the limitations of this article, reference is made to the original work for detailed study.<sup>21</sup> Thus, an outline of the method of appraisal will suffice. Downs divides his analysis into two groups: those measurements primarily devoted to establishing the skeletal pattern; and measurements primarily descriptive of the denture in its relationship to the skeletal pattern.

The skeletal pattern (Fig. 8) in norma lateralis is described by the angular relationships of various planes. The facial angle is an expression of facial type, specifically the degree of recession or protrusion of the chin (1). The mean reading is 87.8 degrees; the range is from 82 degrees, indicating a recessive chin, to 95 degrees for a protrusive chin.

**ASSESSMENT OF ANTEROPOSTERIOR DYSPLASIA**

Female

Dimension	Standard	Patient's	Difference	
			Orthognathic	Prognathic
Glenoid fossa to sella	17	21	4	
Sella to ptm.	17	15		2
Maxillary length	52	60	8	
Ptm. - <u>6</u>	16	22	6	
Mandibular length	101	109		8
H.G. ♀ Age 16		Totals:	18	10

Units of anteroposterior  
dysplasia = prognathic-orthognathic:

-8

Fig. 6.—Method of appraising anteroposterior dysplasia. Example of a Class II, Division 1 malocclusion. The total number of units is more important than any single measurement, which might be cancelled out by a compensatory value of another criterion of anteroposterior dysplasia. (Wylie.)

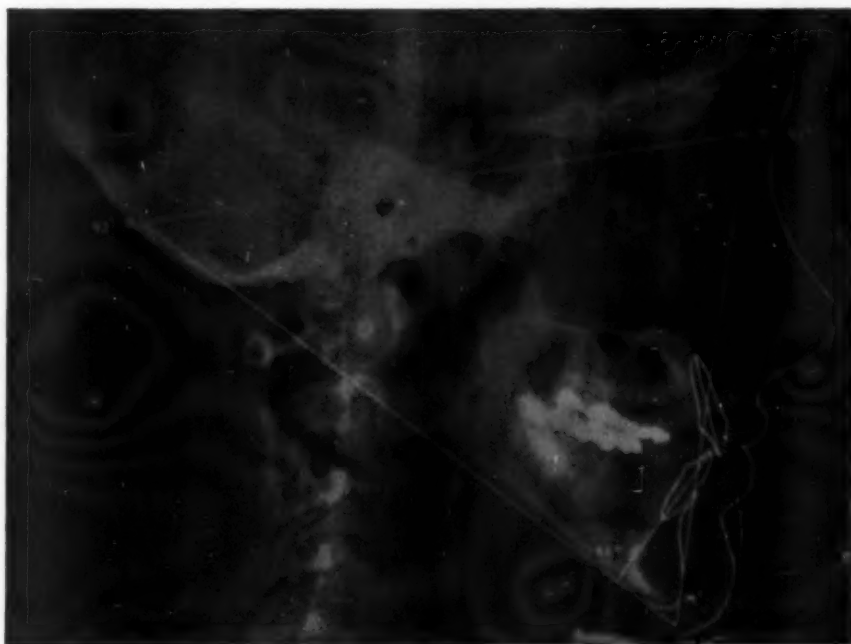


Fig. 7.—The Margolis MFT (Maxillofacial triangle), the basic facial pattern, as established by a study of skulls and living children 6 to 19 years of age, all with so-called normal occlusion.

NAME B. D.  
 AGE 9 years  
 DATE 8-3-53

CEPHALOMETRIC ANALYSIS

NORTHWESTERN UNIVERSITY DENTAL SCHOOL  
 Department of Orthodontics

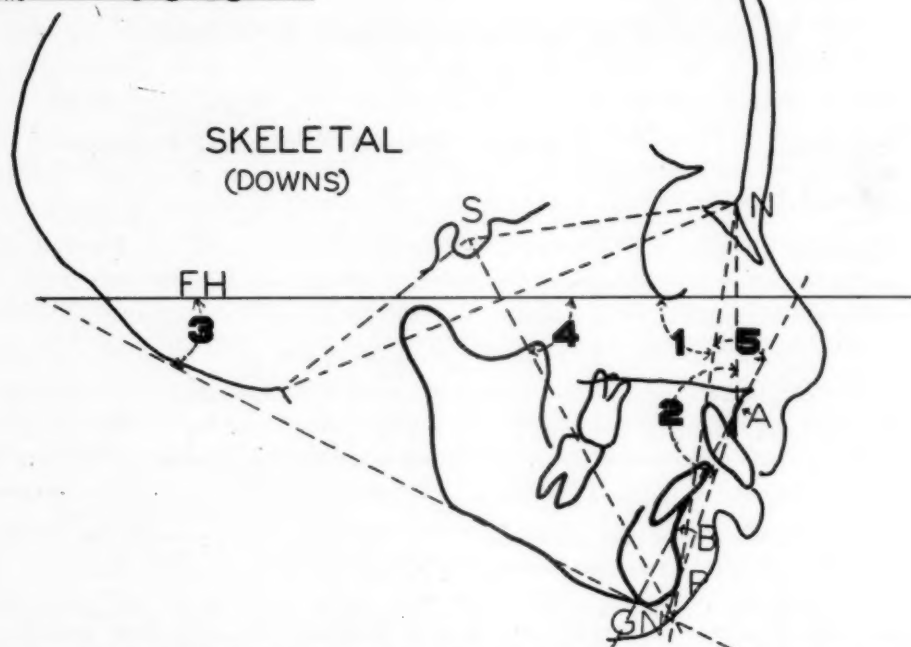


Fig. 8.—Cephalometric tracing, after Downs, showing skeletal criteria of appraisal. 1, Facial angle (FH-NP); 2, angle of facial convexity (NAP); 3, FH-MP angle; 4, growth axis (SGn-FH); 5, apical base relationship (AB-NP).

NAME B. D.  
 AGE 9 years  
 DATE 8-3-53

CEPHALOMETRIC ANALYSIS

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 Department of Orthodontics

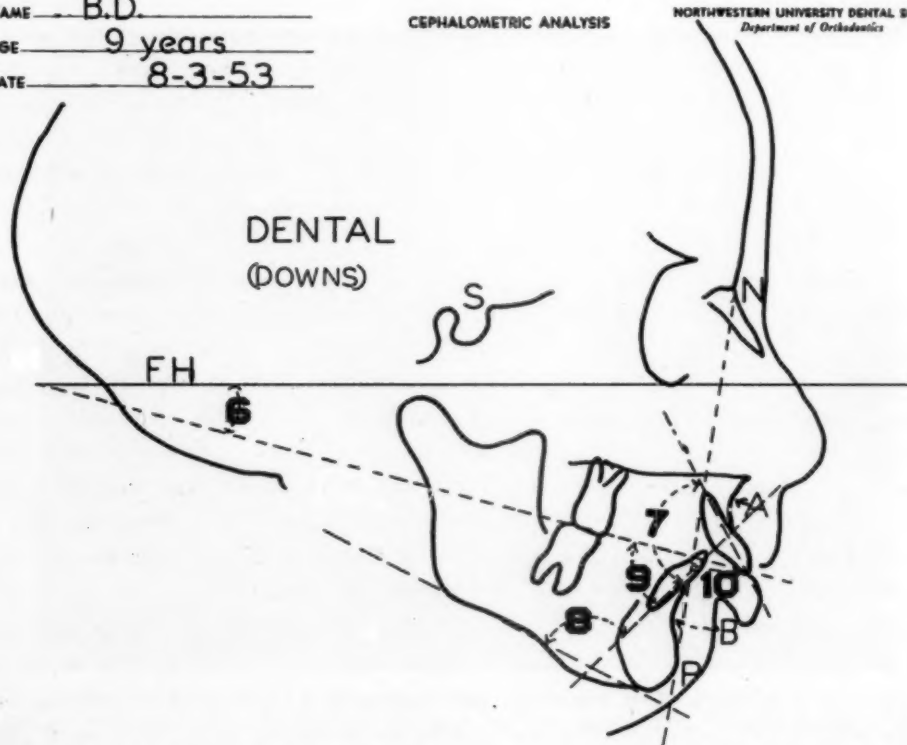


Fig. 9.—Cephalometric tracing, after Downs, showing dental criteria of appraisal. 6, Inclination of occlusal plane (FH-Occlusal plane); 7, angle formed by intersection of long axes of upper and lower central incisors; 8, angle of long axis of lower central incisor with mandibular plane; 9, angle of long axis of lower central incisor with occlusal plane; 10, a linear measurement of the amount of protrusion of the maxillary central incisors in reference to the facial (NP) plane.

The angle of convexity N-A-P (2) (mean 0 degree, range plus 10 degrees to minus 8.5 degrees) is a measure of the protrusion of the maxillary part of the face to the total profile.

The mandibular plane angle (3) is also a measure of mandibular retrusion, according to Downs. (Mean 21.9 degrees, range 17 to 28 degrees.) In his study of twenty individuals, Downs found a significant tendency toward a larger mandibular angle, with a smaller facial angle.

The Y axis expresses the downward and forward growth of the face from beneath the cranium (4). The angle formed with the Frankfort plane (mean 59.4 degrees, range 55 degrees to 66 degrees) gives an indication of the individual's direction of growth—downward and forward, downward, or downward and backward.

The AB, or apical base plane (5) forms an angle with the NP, or facial plane, and gives an appraisal of the relationship of the denture bases to each other and to the profile. (Mean -4.8 degrees, range from 0 degree to 9 degrees.)

In establishing the relationship of the denture to the skeletal pattern, Downs measures the cant of the occlusal plane (6) (Fig. 9), the axial inclination of the upper and lower incisors to each other (7), the axial inclination of the lower incisors to the mandibular plane (8), axial inclination of the lower incisors to the occlusal plane (9), and the amount of protrusion of the maxillary incisors in reference to the facial plane (10).

Downs cautions that his study represents a mean or average form. Variation is inherent. Most important is the recognition that no single figure means much by itself. "What counts is the manner in which they all fit together, and their correlation with type, function and esthetics." Recently, Adams and Vorhies applied Hellman's "wiggle graphs" to the Downs analysis.<sup>22</sup> It is possible to plot an individual analysis and tell at a glance where a patient fits in relation to the means and ranges of a representative group of excellent occlusions (Fig. 10).

In 1948, Riedel did a study on individuals with clinically excellent occlusion, Class II, Division 1, Class II, Division 2, and Class III malocclusions (Fig. 11). He found no significant difference in individuals with normal occlusion or malocclusion of the teeth as far as the anteroposterior position of the maxilla is concerned. The variant is the mandible.<sup>23</sup> In his appraisal of 133 individuals, Riedel used S-N as a cranial base. He measured the relative positions of the anterior aspects of the maxillary and mandibular apical bases. Riedel's work, together with cephalometric criteria gleaned from the Downs analysis, Mayne's study, and the research of Freeman and Rasmusson, forms the basis of the approach used at Northwestern University.

Recently Tweed, introducing his modification of the Margolis maxillo-facial triangle, wrote, "I am confident that I can now outline a formula or an analysis, which if closely followed by the younger man, will allow him to produce the beautiful end results of orthodontic treatment that were heretofore only possible after years of experience and much study. In addition, it will accurately tell him when extraction of teeth is indicated, and when such a

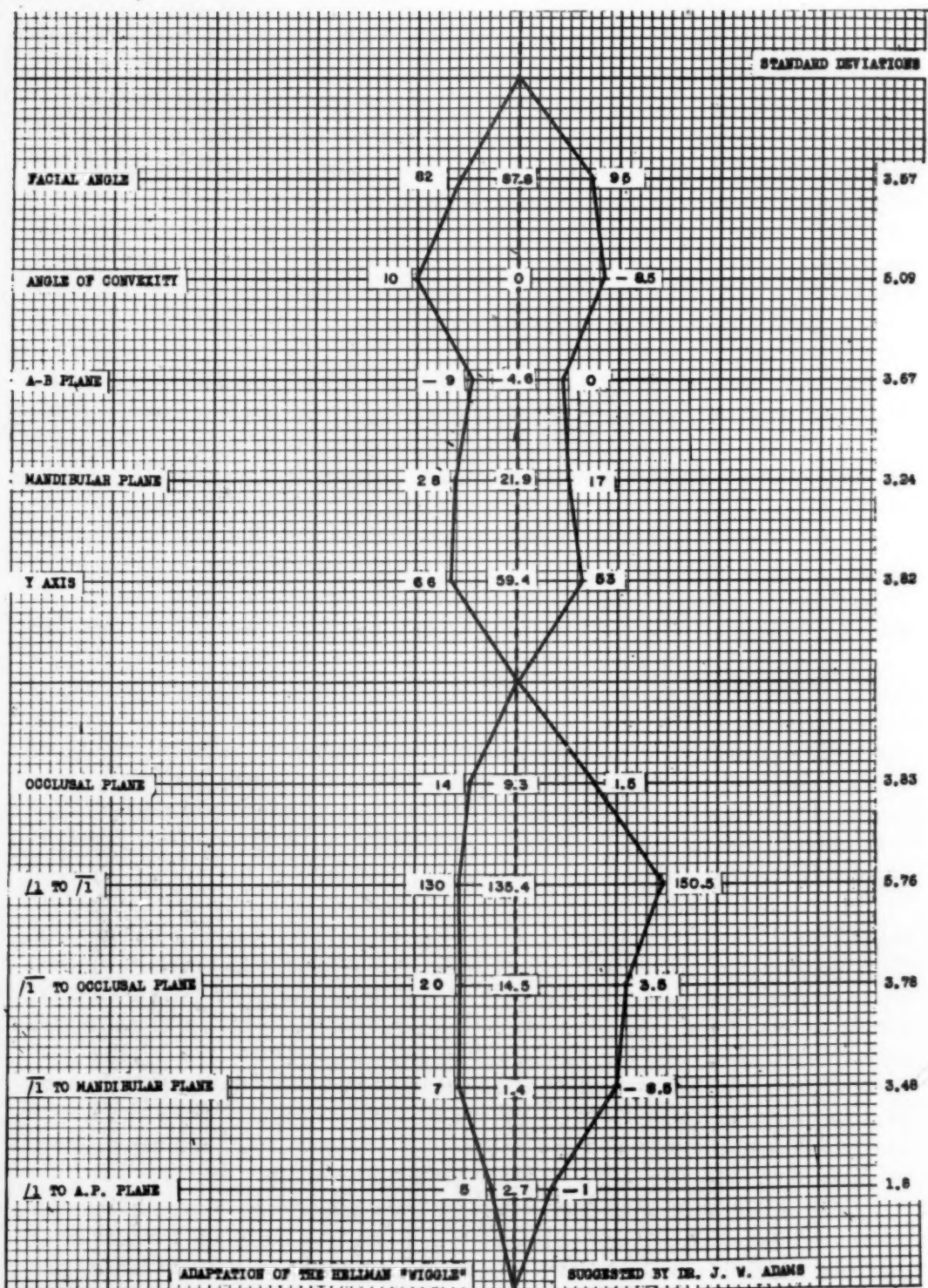


Fig. 10.—Polygon originally developed by Hellman, and used by Vorhies and Adams with the Downs analysis to demonstrate variations in dentofacial pattern.

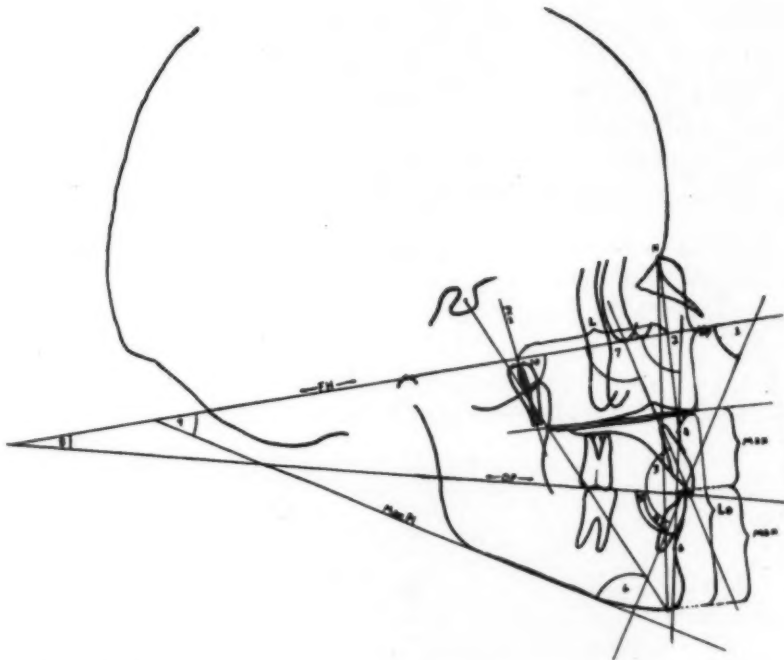


Fig. 11.—Measurements employed by Riedel in a study of normal, Class I, Class II, and Class III malocclusions.

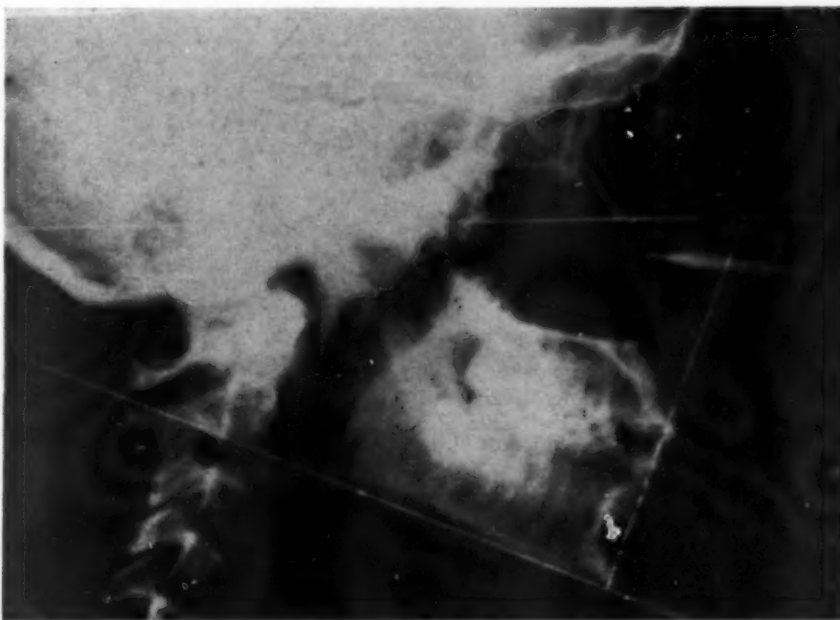


Fig. 12.—Tweed modification of Margolis MFT. The Frankfort horizontal is used as a cranial base. The measurements are based entirely on inclination of the mandibular plane with Frankfort, and inclination of the lower central incisor with Frankfort and mandibular planes. No attempt is made to assess the maxilla or maxillary teeth with respect to the mandible or cranial base. (From Tweed: *Alpha Omegan*, 1952.)

procedure is not indicated."<sup>24</sup> Accepting 25 degrees as a norm for the Frankfort-mandibular plane angle, and 90 degrees for the lower incisor-mandibular plane angle, then a line through the long axis of the lower incisor carried superiorly until it intersects the Frankfort plane would make an angle of 65 degrees, a desirable angulation and treatment goal (Fig. 12). Tweed states that if the Frankfort-mandibular plane angle is increased, then both the incisor-mandibular plane and incisor-Frankfort plane angles would have to

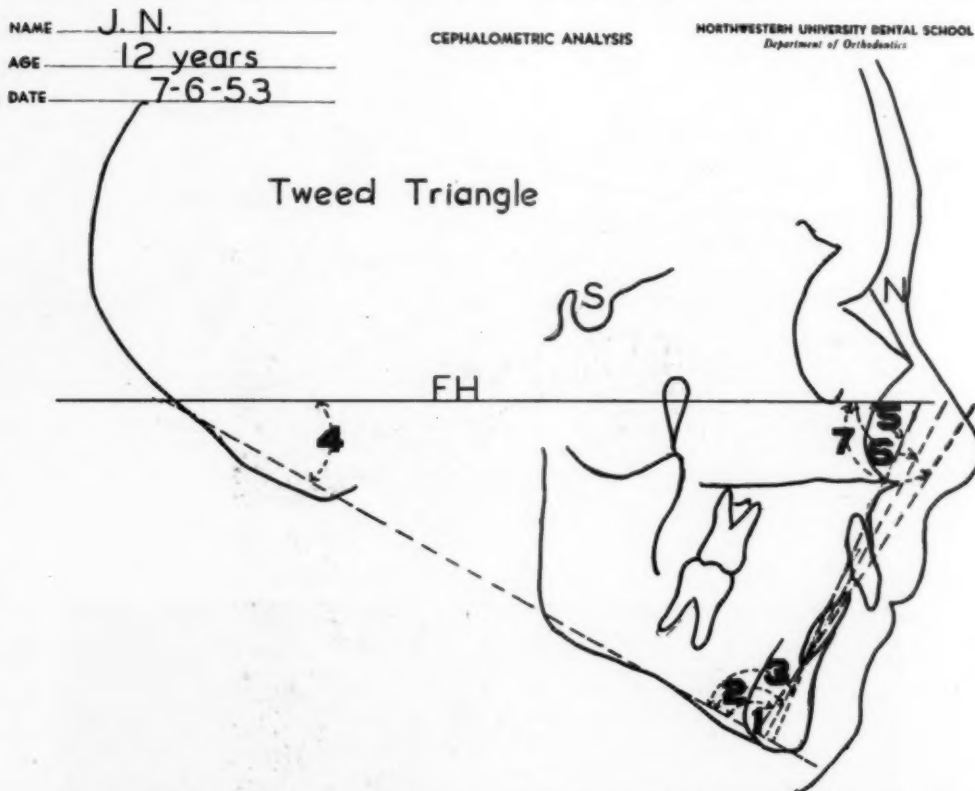


Fig. 13.—Tracing of cephalometric radiograph, to demonstrate how the Tweed triangle works. 1, The original inclination of mandibular incisor with mandibular plane (94 degrees); 2, "normal" incisor inclination (90 degrees); 3, treatment goal in this particular case is an inclination of 85 degrees to compensate for excessive Frankfort-mandibular plane angle; 4, Frankfort-mandibular plane angle (30 degrees) or 5 degrees over "normal"; 5, treatment goal of 65 degrees obtained by establishing the 85 degrees' inclination of the lower incisor with mandibular plane; 6 and 7 are the original and intermediate inclinations of the upper incisor with Frankfort plane. The most important consideration is the inclination of the lower incisor with Frankfort plane. The goal must always be 65 degrees, subordinating the inclination of this tooth with the mandibular plane. Again, no account is made of maxillary relationship to mandible or cranium.

decrease to make 180 degrees for the triangle. For example (Fig. 13), if the Frankfort-mandibular angle is 30 degrees (or 5 degrees above "normal") and the lower incisor angle is 94 degrees (or 4 degrees above "normal"), then the lower incisor must be tipped back to 90 degrees for normal inclination, and then tipped back another 5 degrees to compensate for the excessive Frankfort-mandibular plane angle. This would restore the lower incisor-Frankfort angle to 65 degrees.

In this all-too-brief survey of cephalometric criteria, there is one strong continuous thread—the attempt to construct a norm or standard. The need

for such a standard on which to base our case analyses and therapeutic goals cannot be challenged. The actual creation of this norm concept has been most difficult, fraught with the pitfalls of mathematic expression of morphologic and physiologic variance. Attempts to reduce anatomic and functional relations to angles and numbers, changing a three-dimensional phenomenon into a two-dimensional linear diagram, have led some of us astray. Unfortunately, the Procrustean bed of conformity, of normalcy, has had the same fatal attraction to some orthodontists as Scylla and Charybdis had for ancient mariners in the Strait of Messina. Perhaps, too, our ideas on what we would like to see as normal and what actually exists in experience have been working at cross purposes. In retrospect, it is easy to say that attempts to set up a norm have at times in reality set up an ideal that is philosophically a therapeutic beacon but, practically, a therapeutic impossibility. Even Angle can be accused of using a dual standard. He chose the beautifully balanced straight



Fig. 14.—Angle's ideal, Apollo Belvedere, the classic Greek straight profile. (From Angle: *Mal-occlusion of the Teeth*, ed. 7, S. S. White Dental Mfg. Co., publishers.)

profile of Apollo Belvedere for his ideal face (Fig. 14), and the "Old Glory" he showed to demonstrate an ideal occlusion was taken from Broomell and was the skull of a prognathic colored male (Fig. 15).<sup>25</sup> These two concepts are totally irreconcilable. No more tenable is a converse proposition—an ideal of upright teeth in a strongly convex face. In cephalometrics, we must beware of the same fatal diathesis. Any norm standard must be sufficiently broad to encompass all variations. This does not mean that, because we are unable to set up a simple arbitrary standard to fit our needs, we must discard the whole thing. As Simon sagely observed, "A widely prevalent attitude regards the normal as something real or natural, something provided for us by the outer world of things. But this, alas, is a delusion—all we ever find are variations,

endless variations; an exact ideal normal does not exist, cannot exist. And this is our enigma: in theory we will never find the normal; in practice, we forever feel its need and apply it constantly."<sup>3</sup>

Studies at Northwestern University have shown us the broad range of combination of cranial and facial components. To accept a mean as an absolute treatment goal is to ignore a majority of the populace. To arbitrarily select one or two convenient measurements as prognostic or therapeutic clues is to overlook the interdependence of multiple *individual* characteristics, which are unrecognizable in cross-sectional groupings of so-called normals. Our goal must be, then, an individualized norm, using group standards only as a guide.



Fig. 15.—Angle's "Old Glory" taken from Broomell. This is the skull of a prognathic colored male. (From Angle: *Malocclusion of the Teeth*, ed. 7, S. S. White Dental Mfg. Co., publishers.)

Relations of facial components vary broadly, depending on the facial type—whether the face is forward divergent or backward divergent—whether the face is concave or convex. The implication here is that there are two major considerations, the position of the maxilla anteroposteriorly in the face (with reference to the cranium), and the relation of the mandible to the maxilla, which is responsible for the convex, straight, or concave profile line. If the maxilla is protracted in its relationship to the cranium, the profile is more likely to be convex. If the maxilla is retracted, the profile is more likely to be concave. However, with a maxillary protraction, the face can be convex, straight, or concave (Fig. 16). The same holds true in a face where the maxilla is retracted in relation to the cranium (Fig. 17). This is further complicated by an appraisal of general facial type, whether it is dolichocephalic (long and narrow) or brachycephalic (short and broad). Observations of large groups would seem to indicate that the dolichocephalic individual (or so-called Nordic type) is more likely to have a straight facial profile. The brachycephalic type (for instance, Slavs, eastern European groups, etc.) is more prone to profile convexity. Racial admixtures make any clear-cut correlation

impossible. Nevertheless, incisor tooth inclinations vary as the maxillary protraction or retraction and as the relative facial convexity. The skeletal morphology strongly affects the tooth position and inclination. From our studies of clinically excellent occlusions, it would appear that the apical base difference (maxilla to mandible) is routinely greater with the maxilla protracted in relation to the cranium. There is a markedly greater tendency toward facial convexity and incisor procumbency. With maxillary retraction, the incisor teeth seem to be more upright over basal structures. The antero-

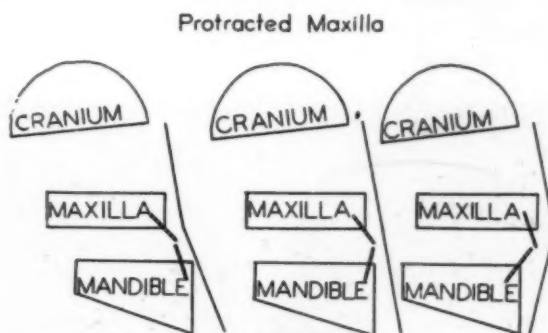


Fig. 16.—Diagrammatic representation of individuals with clinically excellent occlusion, and with the maxilla protracted, or anteriorly positioned, with respect to the cranium. Depending on relation of mandible to maxilla, the face can be convex, straight, or concave. The inclination of maxillary and mandibular incisors to each other and their respective bases must change to accommodate the change in basal relationships. No "normal" is possible to accommodate all three types.

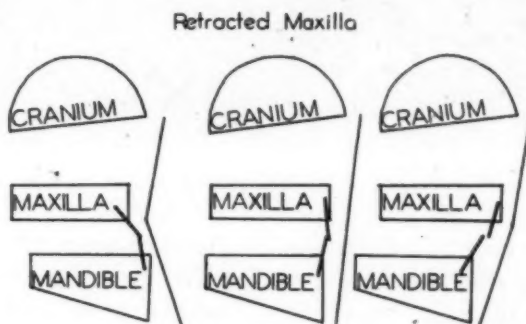


Fig. 17.—Diagrammatic representation of individuals with clinically excellent occlusion, but with the maxilla retracted, or posteriorly positioned, with respect to the cranium. Here, again, the face may be concave, straight, or convex. Marked changes in incisor inclination are necessary with changing maxillomandibular relationships. Compared to Fig. 16, incisor inclinations are generally more upright, or lingually disposed. Within the so-called normal range, basal differences are more moderate. Any appreciable basal difference predisposes to Class II or Class III tendencies.

posterior apical base discrepancy here is consistently less. For example, Fig. 18 shows profile pictures of two patients with clinically excellent occlusions. An examination of the cephalometric tracings will show a broad difference in the relation of facial and dental components. In the straight face, with a maxillary retraction (Fig. 19), the upper incisors are 98 degrees to the SN plane, the lower incisors 85 degrees to the mandibular plane, the anteroposterior apical base difference 1 degree. In the convex face, with maxillary protraction (Fig. 20), the upper incisors are relatively procumbent at 113 degrees, the lower incisors 99 degrees, the apical base difference 5 degrees.

The Frankfort-mandibular plane angle in both patients is 26 degrees. Both dentures are in balance and are healthy, functioning units. This is not a sporadic example, for in the study of a large group of individuals with clinically excellent occlusions it has been shown that the balance of parts obtained by nature varies as the relative maxillary protraction or retraction and the degree of convexity vary. There is a positive correlation between the antero-posterior apical base difference and the amount of incisor procumbency.<sup>26</sup> Corollary to this is the observation that there are larger maxillomandibular basal differences in individuals whose maxillary apical bases are protracted in relation to the cranium.



Fig. 18.—Clinically excellent occlusion. Straight and convex facial profiles.

If we must use a norm as a guide, does it not seem plausible to determine the facial type first, and pick the norm for that type? As valid as this may be in Class I (Angle) malocclusions, it is in Class II, Division 1 types that the real difference is noted. In a study of 150 Class II, Division 1 cases just completed, the apical base difference averages 5.5 degrees, as contrasted to 2.5 degrees in a group with clinically excellent occlusions.<sup>27</sup> In one phase of this study, anteroposterior apical base difference was correlated with the S-N—mandibular plane angle, the latter supposedly a guide for the severity of the problem. A thorough biometric analysis revealed an insignificant statistical relationship. Specifically, what does this mean? It means, first, that we are not facing facts about facial relationships if we arbitrarily predetermine inclination of individual teeth, ignoring qualifying variations in apical base relationships. The mandibular incisors may have an inclination of 85, 90, 95 or 99 degrees and still be normal, depending on facial type and maxillomandibular relationship. Second, *the clinical impression of the validity of the mandibular plane angle as a prognostic guide would not appear to be substantiated in Class II malocclusions* on the basis of the degree of anteroposterior basal dysplasia, the most im-

NAME J. B.  
 AGE 13 years  
 DATE 8-2-53

CEPHALOMETRIC ANALYSIS

NORTHWESTERN UNIVERSITY DENTAL SCHOOL  
 Department of Orthodontics

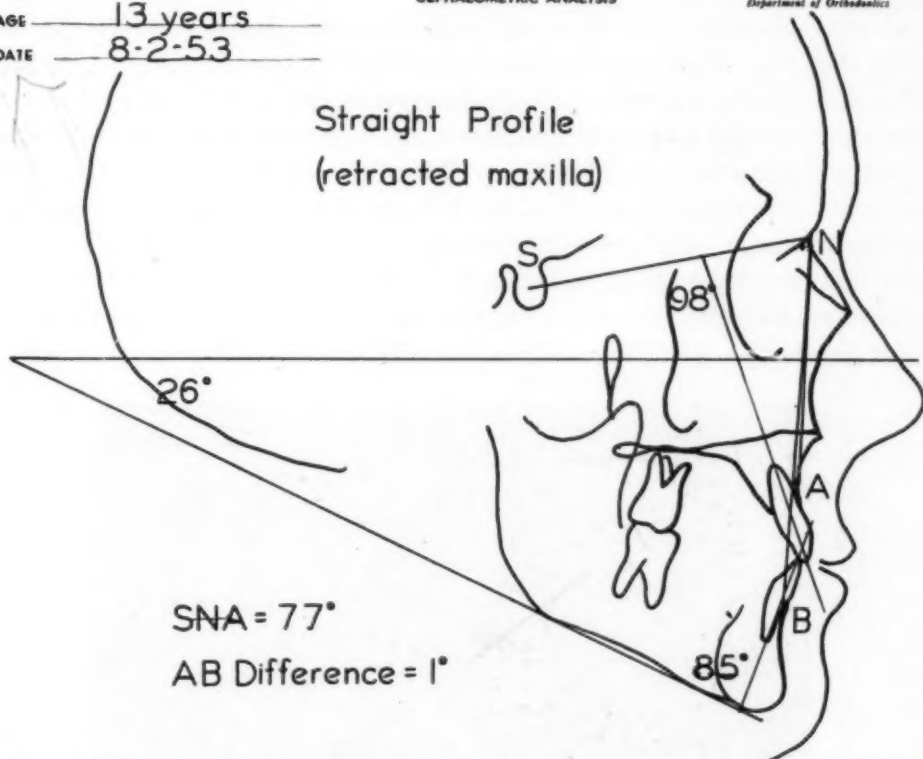


Fig. 19.—Straight profile, maxilla repositioned in relation to cranium. Basal difference is small; incisors are upright.

NAME A.N.G.  
 AGE 12 years  
 DATE 8-2-53

CEPHALOMETRIC ANALYSIS

NORTHWESTERN UNIVERSITY DENTAL SCHOOL  
 Department of Orthodontics

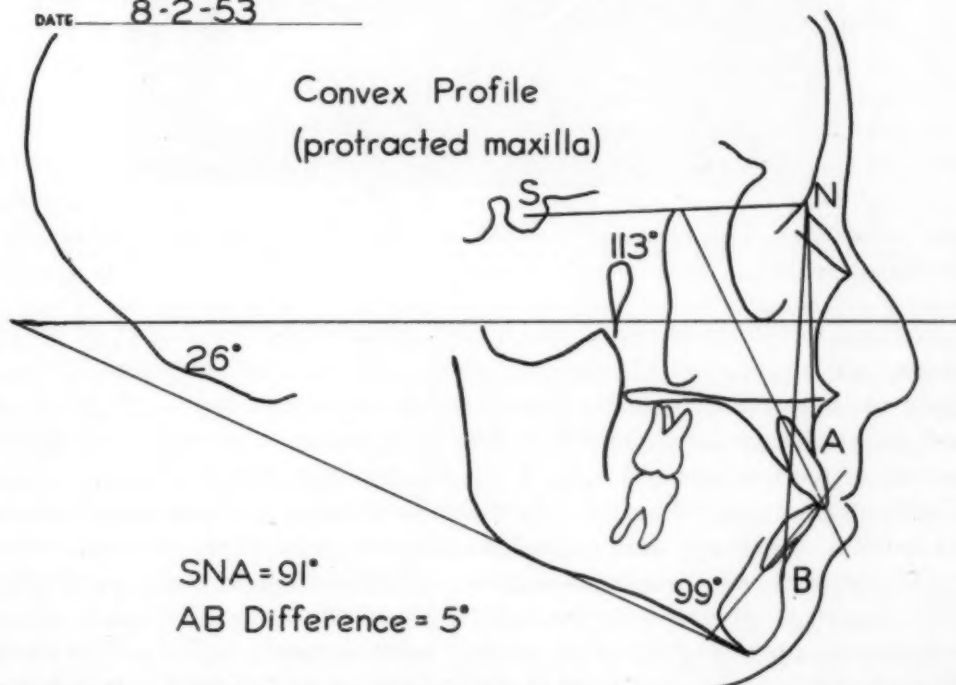


Fig. 20.—Convex profile, maxilla forward in relation to cranial base. The basal difference is large. Maxillary and mandibular incisors are more procumbent, but in balance. The Frankfort-mandibular plane angle is the same as in Fig. 19.

portant characteristic of a Class II (Angle) malocclusion. It follows, then, that the changing of the inclination of the lower incisors because of the steepness of the mandibular plane in a direction that will only increase the overjet and overbite in severe Class II malocclusions, irrespective of inherent pattern, irrespective of the position of the maxilla and maxillary incisors, irrespective of the balancing muscular forces, and irrespective of the possible creation of temporomandibular joint pathology, might be open to some question. This is further substantiated by cephalometric evidence demonstrating insignificant basal changes as a result of conventional orthodontic therapy, limited to intra-oral appliances.



Fig. 21.—Cephalometric landmarks that show least reliability in routine clinical cephalometrics. While quite valuable in growth studies and serial analysis, individual patient differences, bony superimpositions, and variability of recording by different observers make these landmarks less valuable.

Considerable criticism has been leveled at cephalometrics because of the vagueness of landmarks and measure points. All too often, criteria which are reliable for one trained observer, fail to pass the test of reliability when exposed to the average clinician. Our goal in cephalometrics must be analyses based on criteria reproducible by a considerable number of observers, with deductions reasonably in accord. To do this, we must at times sacrifice landmarks which, developmentally speaking, theoretically might be more valid. In this category are Bolton point, spheno-occipital suture, anterior nasal spine, pterygomaxillary fissure, orbitale, and porion. To a lesser degree, gonion should be included (Fig. 21). In growth studies, Bolton point as a posterior terminus to a cranial plane from nasion is undoubtedly valid, and preferred,

as the superlative work of Broadbent has shown. For the clinical orthodontist, who is not able to follow his patients for years and who must make his analysis from a single headplate before treatment, the downward proliferation of the mastoid process, superimposing over Bolton point, makes Bolton point difficult to pick up. The spheno-occipital synchondrosis, posterior terminus of the Margolis cranial plane is in the same category, and is even less reliable. Anterior nasal spine and pterygomaxillary fissure are highly variable. Orbitale, the lowest point on the inferior margin of the orbit, is very hard to see in certain lateral headplates. Porion, the posterior terminus of the Frankfort plane, is a hybrid landmark—part machine, part soft tissue counterpart of the bony external auditory meatus. Porion may vary from time to time, depending on the positioning of the patient. Gonion depends on the curvature of the mandibular angle. The actual point, bisecting the arc at the angle, may vary significantly from one time to another, and from one observer to another.

Wylie's analysis is valuable in determining the area of actual dysplasia. However, in a recent article,<sup>28</sup> he wisely points to the inaccuracy of certain landmarks used (condyle, pterygomaxillary fissure, and anterior nasal spine) which reduce the effectiveness for the average clinician in daily use. There is also contradictory evidence of Buckley and Riedel, showing that in Class II and Class III malocclusions, the mandible is mostly at fault, with the maxilla maintaining a fairly stable relationship to the cranium.

With the goal of reliability of landmarks in mind, with a full knowledge of the limitations imposed by facial types and basal relationships, and with a recognition of the need for a simple and accurate cephalometric analysis, imparting information that will help the clinician formulate his diagnosis and determine his prognosis, the following cephalometric analysis is offered as one possible approach to the problem. We have borrowed heavily from the Downs analysis, incorporating the research of Thompson,<sup>29-32</sup> Riedel,<sup>23</sup> Freeman,<sup>33</sup> Ras-musson,<sup>34</sup> Mayne,<sup>14</sup> Donovan,<sup>9</sup> Buckley,<sup>35</sup> Carlson,<sup>36</sup> Williams,<sup>26</sup> and many others at Northwestern University. Since prior publication has described the Northwestern technique,<sup>37</sup> only an outline of the approach will be given here.

As Downs has done, the Northwestern analysis is divided into two parts, skeletal and dental (see Table I). Recognition is made of those areas which influence prognosis and treatment, and of those areas susceptible to orthodontic therapy (Fig. 22). The skeletal measurements are the angle of facial convexity (N-A-P), the mandibular plane angle, and the apical base relationship (Fig. 23). The use of the maxillary and mandibular incurvations (Points A and B) as the anterior termini of the maxillary and mandibular apical bases would appear to be justified, based on clinical experience. By constructing an angle from the S-N plane to points A and B, and taking the difference, the maxillomandibular anteroposterior relationship can be seen. If the SNA angle is high, meaning a maxillary protraction, then the apical base difference can be higher and still not have unfavorable therapeutic connotations. If the SNA reading is low, any appreciable apical base difference may impose severe limitations on the adjustment of the Class II relationship. An alternate method

TABLE I. MEAN AND STANDARD DEVIATION VALUES DERIVED IN STUDIES OF ADULTS AND CHILDREN WITH CLINICALLY EXCELLENT OCCLUSIONS (RIEDEL)

	ADULTS		CHILDREN	
	MEAN	ST. DEV.	MEAN	ST. DEV.
Skeletal:				
N-a-P	+1.62°	4.78°+	4.22°	5.38°
NP-ab			-4.6	3.67
S-N-a	82.01	3.89	80.79	3.85
S-N-b	79.97	3.60	78.02	3.06
Diff.	+2.04		+2.77	
NS-Go-Gn	31.71	5.19	32.27	4.67
FH-NP	88.56	3.17	85.33	2.42
ManPL-FH	26.15	5.95	27.06	4.67
SGn-FH	60.68	3.48	60.58	2.89
Denture:				
S-N-Gn	79.29	3.39	76.93	3.02
1 - NS	103.97	5.75	103.54	5.02
1 -   1	130.98	9.24	130.40	7.34
1 - GoGn	93.096	6.78	93.52	5.78
1 - OP	69.37	6.43	71.79	5.16
ab - OP	91.28	3.46	92.08	3.64
1- NP (mm)	5.51	3.15	6.35	2.67

(From Graber: AM. J. ORTHODONTICS, August, 1952.)

of determining the basal relationship (Fig. 24) is to construct a perpendicular to the SN plane from Point A, and draw a line from the intersection X to Point B. The resultant angle takes into consideration the facial divergency, and is not dependent on the position of nasion in the face. The measurement of the inclination of the mandibular plane to a cranial base plane (Angle

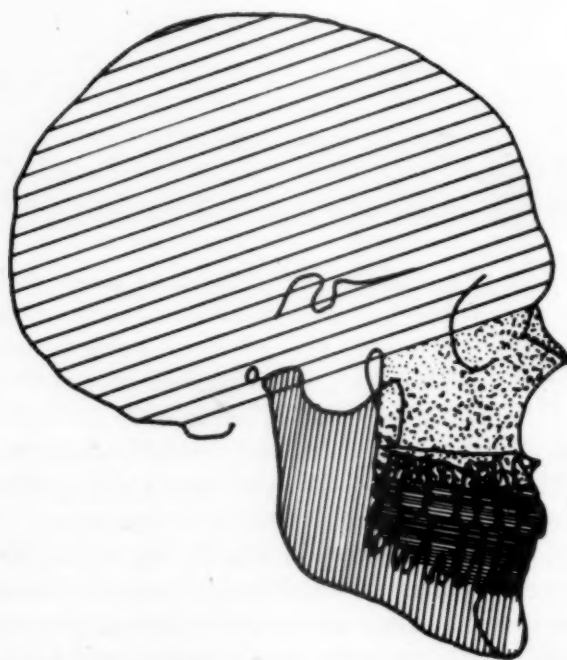


Fig. 22.—From Downs, showing alveolar bone, basal or supporting bone of the maxilla and mandible, and the cranial base. Only the alveolar bone is under direct influence of orthodontic therapy. Basal changes depend on growth increments during therapy. Cranial changes are negligible at the age most orthodontic treatment is instituted.

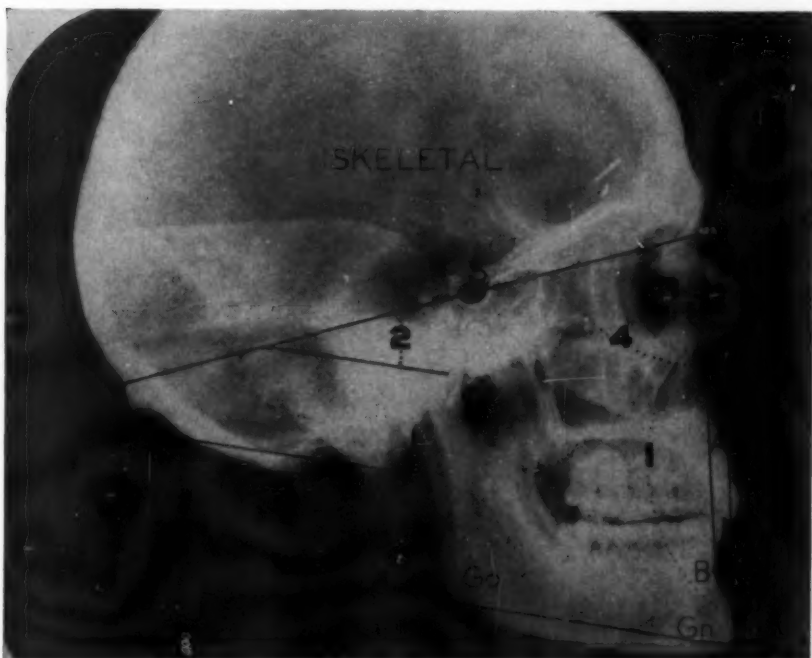


Fig. 23.—Skeletal analysis. 1, Angle of facial convexity (NAP); 2, Sn-GoGn angle; 3, angle SNA; 4, angle SNB. By subtracting 4 from 3 (SNB from SNA) the apical base difference can be determined.

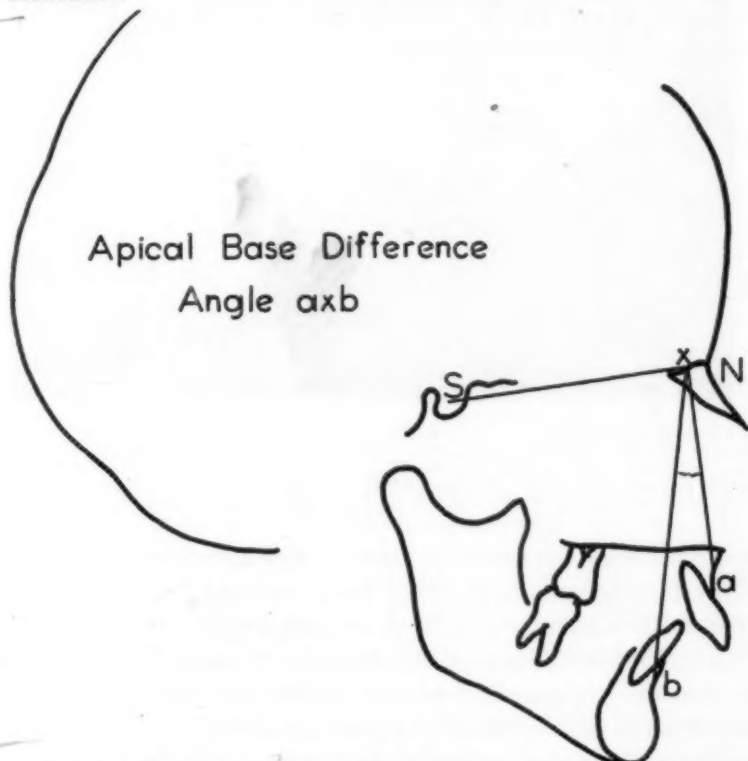


Fig. 24.—Apical base difference, determined by constructing a perpendicular to the SN plane from the maxillary incurvation (Point A) and drawing a line from the point of intersection X down to the mandibular incurvation (Point B). (From Graber: AM. J. ORTHODONTICS, August, 1952.)

GoGn—NS) does not appear to be the infallible criterion of anteroposterior dysplasia once thought. However, this angle is measured because of other therapeutic considerations. Steep mandibular plane angles impose severe limitations on the correction of excessive overbite; occlusal plane changes induced by intermaxillary elastics are seldom permanent; functional disturbances are more likely.

The denture analysis is a study of the area and structures the clinician can influence (Fig. 25). The angulation of the upper incisor to the N-S or cranial plane is measured. Its axial inclination and anteroposterior position in the face are important in an analysis of the individual problem. A Class II, Division 1 malocclusion with upright incisors and no spaces is an entirely different problem to treat than the same class malocclusion with the same amount of overjet, but with labial inclination and spacing of maxillary incisors.

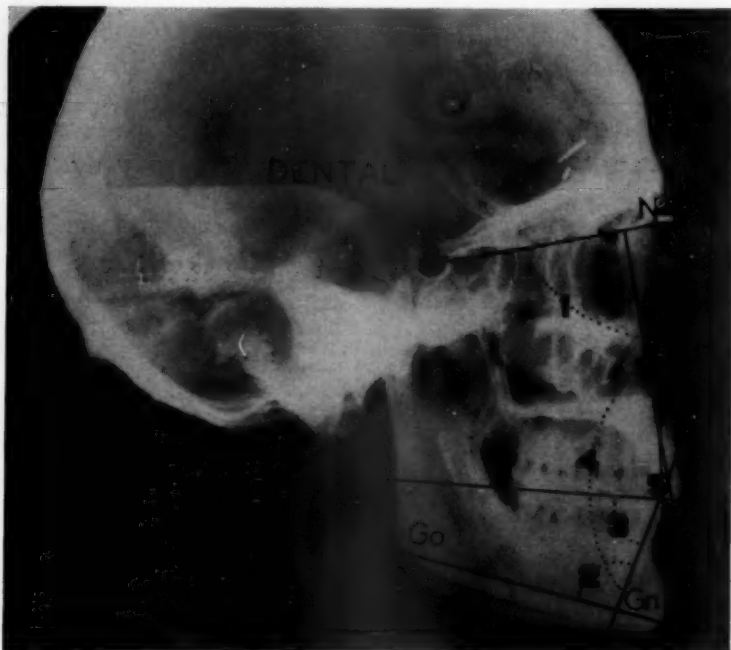


Fig. 25.—Denture analysis. 1, Angulation of the upper incisor to the NS plane; 2, angulation of the lower incisor to the mandibular plane; 3, angulation of the lower incisor to the occlusal plane; 4, angle formed by intersection of long axes of upper and lower central incisors; 5, linear measurement from the tip of the maxillary central incisor, perpendicular to the NP or facial plane. See Table I for means and standard deviations for these criteria.

The inclination of the lower incisor to the mandibular plane is recorded. Studies at Northwestern have shown a broad range of lower incisor inclination in individuals with clinically excellent occlusion, with an even larger standard deviation than the inclination of the maxillary incisor. This means that the mandibular incisor is more variable in its inclination than the maxillary incisor in individuals with clinically excellent occlusion. Any value, however, must be conditioned by the skeletal phase of the analysis. An apparently normal or erect lower incisor in a backward divergent face with a Class II malocclusion and high apical base difference presents an entirely different prob-

lem for treatment than it would in a forward divergent face, with a Class I malocclusion and a small anteroposterior basal difference. The same standard cannot be used. Some clinicians prefer to measure the inclination of the lower incisor to the occlusal plane, pointing to the smaller standard deviation. The inference in justifying the choice is that the mandibular incisor is more dependent on the cant of the occlusal plane than on mandibular morphology. Certainly, the dictates of logic and sound treatment planning mitigate against the arbitrary selection of a "normal" inclination for any tooth, if in so doing, the clinician ignores equally important or more fundamental considerations such as relation of maxilla to cranium, apical base relationship, limitations of mechanotherapy, etc.

The relation of the upper and lower incisors (angular reading of the intersection of the long axes) shows the greatest variability of all criteria, and is the least reliable from a diagnostic point of view. However, because control over both upper and lower incisors is possible, changes wrought by treatment are reflected in the greatest magnitude here. Facial type again qualifies the ultimate objective.

More importance can be attached to the position of the maxillary incisor with respect to the facial plane. This is a linear measurement from the incisal edge, perpendicular to the NP or facial plane. Though skeletal limitations may plague any severe Class II malocclusion, it is in the lingual tipping of the maxillary incisors that the greatest esthetic change is produced. Restoration of normal lip posture is often the major accomplishment subsequent to therapy and retention, after the denture has re-established its morphogenetic dominance and functional equilibrium.

Of necessity, mean values have been determined for all these criteria, along with standard deviations to show relative spread. But these measurements serve only as a guide, illustrating central tendency. Prognosis and treatment considerations must be based on the relations of the component parts within the particular patient under consideration. Thus, a patient with a Class II, Division 1 malocclusion, protracted maxilla, and a moderately large maxillomandibular basal difference, will allow a greater labial inclination of incisor teeth for a stable result. This is recognized when the skeletal cephalometric measurements are correlated with those of the denture. Second, the limitations of apical base relationship may be wholly inconsistent with the demands of a "normal" occlusion. This may be illustrated by the following diagrammatic representations of actual cases (Figs. 26 and 27). Both are Class II, Division 1, the Frankfort-mandibular plane angle is 30 degrees, the inclination of incisors to basal planes identical (107 degrees for the upper, 90 degrees for the lower). The variable factor lies in the anteroposterior apical base difference. To have the same ultimate objectives for incisal inclination would be most unwise. In the low AB case, the upper incisors were tipped lingually 7 degrees, and the lower incisors labially 4 degrees to establish normal overjet and overbite. In the high AB case, tooth movement of the same degree still left a large overjet, which could be corrected only by tipping the upper incisors lingually to an all-too-erect 89 degrees, the lower incisors all-

## Low Apical Base Difference

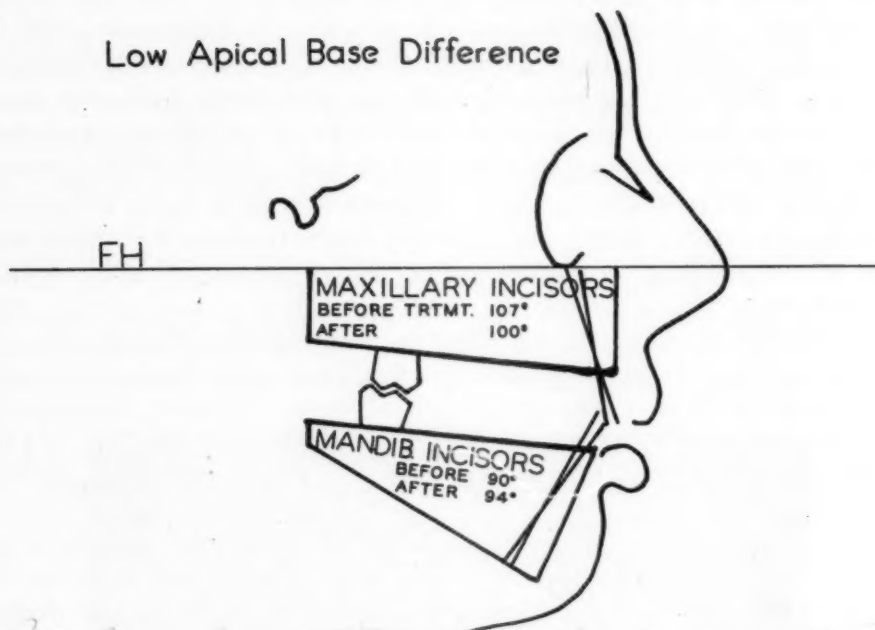


Fig. 26.—Diagrammatic representation of actual Class II, Division 1 malocclusion, with small maxillomandibular basal difference. Incisal inclination changes were slight during the course of therapy.

## High Apical Base Difference

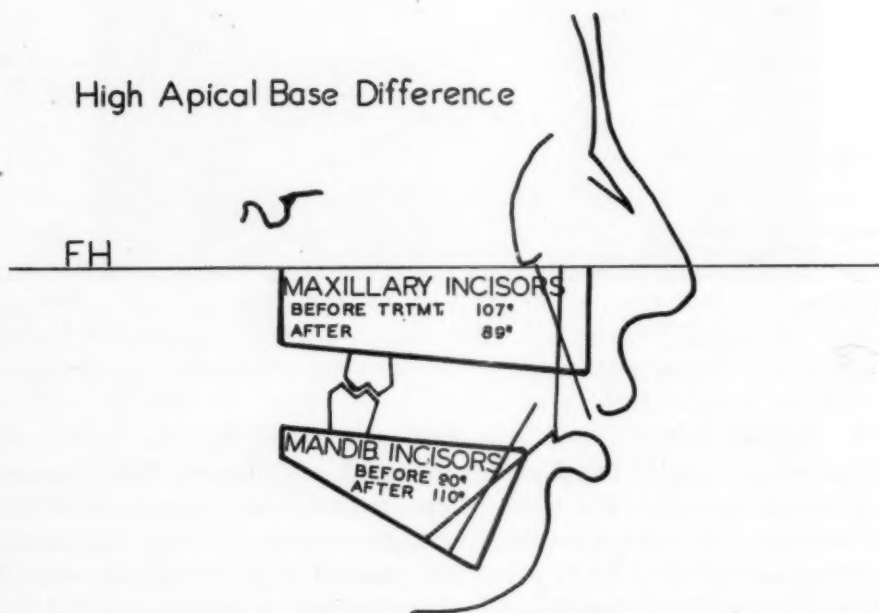


Fig. 27.—Diagrammatic representation of Class II, Division 1 malocclusion with a large apical base difference. While the Frankfort-mandibular plane angle is the same as in Fig. 26, and incisor inclinations are the same before treatment, marked differences are noted in a post-treatment comparison of incisor changes, changes made in an attempt to produce a normal overjet.

too-far labially to 110 degrees. Did it hold? Unfortunately, the answer is obvious. If the lower incisors had been stopped at 100 degrees, then it would have been necessary to tip the maxillary incisors still further lingually to 79 degrees, which was not feasible mechanically, esthetically, or functionally. This is an extreme, but it demonstrates what must be done in variable base relationships, for the apical base difference was the only variable apparent in these two cases. Sacrifice of lower bicuspids would have been tragic. The very obvious philosophical conclusion is that there are certain severe Class II malocclusions incapable of full correction, where attempts at restoration of an ideal occlusion may well produce permanent damage. These cases, and their less severe brethren where ideal treatment may be no more stable, should be recognized prior to therapy. Carried one step further, there are undoubtedly an undetermined number of cases in treatment in which extraction of two upper bicuspids, permitting retraction of the upper anterior segment to provide a normal overjet, confers greater stability and functional equilibrium, despite a Class II buccal segment relationship. Attempts to obtain Class I interdigitation at all costs in Class II malocclusions with a severe basal dysplasia may not only court failure, but also create future problems for the periodontist and prosthodontist.

In summary, the trend in clinical cephalometrics has been from the complex to the simple. Landmarks and measure points are fairly well standardized and accurately reproducible. Cephalometrics, by contributing to the compendium of knowledge on the "why" instead of the "how" serves as a valuable diagnostic tool, drawing out the possibilities and limitations of therapy. Controversy still plays a healthy role in the picture, despite the greater objectivity of our approach. However, the evils of controversy are transitory, while its benefits are permanent—healthy to progress, stimulating to further research. It was John Locke who said, "As there is a partiality to opinions, which is apt to mislead the understanding, so there is also a partiality to studies, which is prejudicial to knowledge."

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## ORTHODONTICS FROM THE PUBLIC HEALTH VIEWPOINT

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DENTAL public health programs as we know them today probably owe their inception to public reaction to the vast number of World War I rejections for dental reasons.<sup>1</sup> It was not until the middle 1930's, however, that a significant number of states began to include dentistry as a part of their total health program. The passage of the Social Security Act in 1935 gave the states the financial lift which permitted expansion of their health department activities to include programs for the control of dental diseases.<sup>3, 4</sup>

From the beginning, the dental profession and public health administrators have been occupied almost entirely with the dental caries problem.<sup>5, 6</sup> Since both state and Federal funds have been limited, the establishment of dental corrective programs has been sporadic and equally limited because of the expense involved. And, because of the overwhelming size of the caries problem, neither dental public health people nor the health agencies they worked for have made any concerted attempts to consider control programs which might be directed toward other dental diseases.

My main purpose today, however, is to review the things the Federal Government has been doing which may be of interest to orthodontists. To set the stage properly, it will be necessary to return to our experiences with the dental caries problem. You will recall that in the early 1930's we attempted to rationalize and build so-called preventive programs around such slogans as "good diet means good teeth" and "a clean tooth never decays."<sup>2</sup>

Fifteen years intervened between the passage of the Social Security Act of 1935 and the official announcements that fluoridation of public water supplies was a safe and recommended dental caries preventive. During that interval, scientists of every discipline developed tools and methods and began to study dental caries in the laboratory and in the field. In my opinion, so many scientific advances were made during the 1940's that the period will go down in history as a fitting tribute to the one hundredth anniversary of dentistry's beginning. From the preventive point of view, we are now able to drop the slogans in favor of methods which truly prevent the inception of dental caries. In public health circles, dentistry has arrived, because today we have a method of controlling a large segment of our caries problem and it can be done at a cost which does not overburden the taxpayer and potential consumer of dental health services. Furthermore, those corrective programs now in operation, if continued along with

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fluoridation and topical applications of sodium fluoride, will become increasingly more effective by the reeducation in the caries problem which the remedial programs are attempting to solve.

What is the analogy and what does this history mean to the practice of orthodontics? I believe many of the dentists closely associated with public health and dental caries research are now reassessing the present status of dentistry. It is evident that there has been a lack of attention on the part of public health workers to periodontal diseases and dentofacial deformities. It also seems obvious that this lack of attention may be partially due to the lack of good solid scientific information on which to build programs to control or prevent periodontal diseases and dentofacial deformities.

Suppose we apply a test to see whether malocclusions are really a public health problem. According to Sinai, a public health problem is "(1) a condition or situation which is a widespread actual or potential cause of morbidity or mortality; (2) about this situation is a body of knowledge which, if applied, would prevent, ameliorate or cure this condition or situation; (3) this body of knowledge is not being applied." Dentofacial deformities fit the definition. The weak point, however, is that the "body of knowledge, which if applied" is largely clinical and may be compared to filling teeth to control the dental caries problem. In other words, the case for using public funds for broad orthodontic treatment purposes has not been completely established, and hence the "body of knowledge is not being applied."

It appears that in the thinking of most health administrators almost any other health problem has a cheaper approach than is now available for the correction of malocclusions. The average cost of treating a case of malocclusion is perhaps twenty times that spent for the average orthopedic case. Guardians of public funds rightly prefer to obtain as large a return as possible and they naturally feel that taking care of twenty orthopedic cases at the cost of one orthodontic case is good business. To the health administrator, orthodontic services are practically priced out of the market.

Health administrators usually prefer to spend their tax dollars for prevention, rather than for treatment, and so they immediately wonder whether a less expensive type of treatment for malocclusion is available, or could be made available, as long as there is no real preventive program to work with. There are exceptions, for some states and communities do pay for treatment of the most severe cases, if not all cases of malocclusion, without being too concerned about a mass preventive for dentofacial deformities.

In mulling over the orthodontic problem, the jaundiced health administrator can ask a number of difficult questions to which accurate and scientific answers are hard to find. For instance, he can ask, "Does the lack of treatment do any harm to the physical growth of a child, or conversely, what scientific evidence is there that an ideal dental apparatus is necessary or actually influences general physical development? What detrimental effect do irregular teeth have in personality development and how bad does the aberration have to be to influence the individual's mental well-being? How

frequently do such cases occur—if they do affect the mental health—or in other words, how big is this portion of the malocclusion problem? Just how much money will I need in my state if I agree to budget funds for orthodontic purposes?”

Immediately a number of other questions arise such as: “Will the experts agree as to which cases need treatment and which do not? Will there be a larger proportion of rural children needing orthodontic services than urban children? How do we get the rural children transported to the specialist? How long will treatment take for the average orthodontic case? Shouldn't we limit the use of our money and direct our attention to just the frank cases of harelip and cleft palate? How many cleft cases should we expect to find in our population, and how do we find them?”

If fairly satisfactory replies are made to the foregoing, he will then ask, “Isn't there a tendency for many cases of malocclusion to correct themselves with the passage of time? Aren't a large proportion of the orthodontic cases simply cosmetic, or at least of an elective nature having little or no bearing on general physical and mental health?”

You see, there are a number of pertinent questions which must be answered before the local administrator of public funds arrives at the problems what the qualifications of the participating orthodontist should be, how he should be reimbursed, and how much each kind of service will cost.

Frankly, it appears that the justification for the use of public funds for support of broad programs for the correction of malocclusions has yet to be made—excluding, of course, outright cleft cases. No criticism is intended. I am simply pointing out that either the facts are not available or they have not been effectively assembled. Thus, until scientifically sustained replies to the foregoing questions have been presented, the widespread use of public funds for the treatment of malocclusions will not be forthcoming. Orthodontics today is in the “clean-tooth-never-decays” stage, at least from the public health viewpoint.

In a review of the literature and a report of an orthodontic survey in St. Louis, Mo., in 1946, Dr. Brandhorst entitled his paper, “Will Orthodontics Become Part of Contemplated Health Programs for Children?”<sup>8</sup> Assuming that the question implies Federal “contemplations,” let us examine what the Federal Government is doing today and determine whether the question can be answered.

Although Federal funds have been available for dental purposes since 1935, it is not proper to say that orthodontic treatment programs are widely supported; nor are they popular and urgently wanted at the local level. Several states, notably California, Colorado, Delaware, and New York,<sup>9</sup> carry on orthodontic projects on a statewide basis, but these are exceptions rather than the rule.

*Children's Bureau.*—In 1950, however, nearly 8,000 children in all states, except Arizona, received services for cleft palate and harelip under the Federal grants-in-aid program of the Children's Bureau which allotted funds to the various state programs for crippled children.<sup>10</sup> This number represents about

one-fifth of those children having a congenital malformation. The proportion of children served in any one state who had clefts, when related to the total number who received services for crippling conditions, ranged from less than 1 per cent of those cases treated in Delaware, the District of Columbia, Rhode Island, and the Virgin Islands, to almost 13 per cent in Ohio. The 8,000 figure seems to be a relatively good performance when one considers that there are approximately 4,500 cleft cases occurring annually.

In the last few years three conferences on orthodontics, attended by outstanding men in this field, have been sponsored by the Children's Bureau. Suggested principles for public orthodontic programs for children were developed and published.<sup>11</sup> The discussion of the cleft palate problem during these conferences pointed to the need for team training in the rehabilitation of children with oral clefts and resulted in "One state . . . using special crippled children's funds to develop at the state university a center for graduate training in the team approach to the problem of rehabilitation of children with cleft palate."<sup>12</sup> The dental school in that state is playing an integral part in this training.

*Rehabilitation.*—Orthodontic services are allowable under the terms of the Rehabilitation Program conducted for persons over 16 years old by the Department of Health, Education and Welfare. The amount of dental services provided under this grants-in-aid program are nominal. Less than 4 per cent of the 1949 funds expended for hospital and medical care went for all dental services, and there were fewer than 2,000 clients. The rehabilitation programs are carried out by nonfederal agencies in each state and the amounts spent solely for orthodontic purposes are not identifiable.<sup>13</sup>

*Federal Support for Research.*—Through Federal funds appropriated by Congress, a number of basic research projects of interest to orthodontists have been supported. Some of these studies have been carried out within the framework of Government research institutions, some by outside agencies under the grants-in-aid programs. A conservative estimate shows the money currently being spent by all agencies, including the grant programs of the Federal Government, for research of interest to the orthodontist to be about a half million dollars annually. It has been stated that less than 1 per cent of the funds appropriated for medical and biologic research are earmarked for all types of dental research.<sup>14</sup>

A recent survey of the financial status and needs of dental schools pinpointed some facts about dental research being carried out in those institutions.<sup>15</sup> While it is not possible to distinguish between dental research relating or not relating to orthodontics, the survey of 1949-50 indicated that 44 per cent of the total expenses for separately budgeted dental research came from Federal funds, almost one-half of which represented Public Health Service grants. Industry supplied 19 per cent of the research funds, foundations 15 per cent, and miscellaneous sources 22 per cent. Even though the amount of Federal Government funds for research are fairly sizable, a number of worthy orthodontic and other dental research projects have gone unfinanced. While some

think the support is not wholly adequate, the Federal Government does play a prominent role in an area of great importance to a relatively young profession.

An illustration of the impact, which may become even more significant if Federal funds continue to foster research work and the training of research workers, is the investigation carried out under one of the Public Health Service grant-supported projects. The study indicated that when female rats were kept on a riboflavin-deficient diet, one-fourth of their offspring were born with skeletal abnormalities.<sup>14</sup> A high proportion of these defects consisted of cleft palates. Here, then, is basic research which happens to have been supported by a grant from the Public Health Service that could be a lead to a simple preventive technique for malocclusions and cleft faces.

While we are on the subject of cleft palate and harelip, one study indicated about 1 of every 800 infants is born with cleft palate.<sup>16</sup> Other studies will be needed to confirm this finding, since the ratio is higher than previously reported in the literature.<sup>17, 18</sup> Another point to be made is that the history of such diseases as venereal diseases, tuberculosis, and cancer suggests it may be time to require reporting of cleft lip and palate in order to provide the data necessary for study and for case finding. All but eleven states have provisions for recording congenital malformations on birth supplement records, but the Census Bureau indicates that listing cleft palate per se is not provided for on any birth record.

*Public Health Service.*—In view of the comparatively satisfactory progress being made in dental caries control, the Public Health Service has begun to give attention to the more seriously neglected fields of dentistry—periodontal diseases and dentofacial deformities. The National Institute of Dental Research has for some time been studying soft tissue diseases. About two years ago the Division of Dental Resources undertook an investigation of dentofacial deformities in the hope of producing facts which might lead to a realistic and scientific preventive program. An advisory committee agreed that epidemiologic and biologic knowledge necessary for a mass preventive program (such as fluoridation for control of caries) is simply not available in orthodontics. Neither is there agreement on a simple and acceptable technique for measuring the prevalence and incidence of malocclusions, hence orthodontic needs.

Although some have objected to the system of counting decayed, missing, and filled teeth, the DMF rate for dental caries has provided the tool for conducting epidemiologic studies and testing the effectiveness of various caries-inhibiting drugs and techniques under experimental conditions. It has played an important role in dental caries research and ultimately in the advancement of dentistry as a scientific discipline.

We undertook to develop a comparable tool for epidemiologic surveys of malocclusion, and the dentofacial index is the result. The dentofacial index (DFI) is derived by using a facial orthometer.<sup>19</sup>

The facial orthometer is a relatively simple, portable, anthropometric instrument which permits direct measurements of an individual's face and

teeth to be combined with several intraoral observations (Fig. 1). A system of weighting the standard deviation, from an orthodontic standard, produces an index which numerically classifies malocclusions from zero to 21. The larger the index figure, the more severe the deformity. The basic instrument has been described in the literature.<sup>19</sup> The method of handling data obtained from the orthometer was submitted to the American Association of Orthodontists last year for the annual competition and has been published.<sup>20</sup>

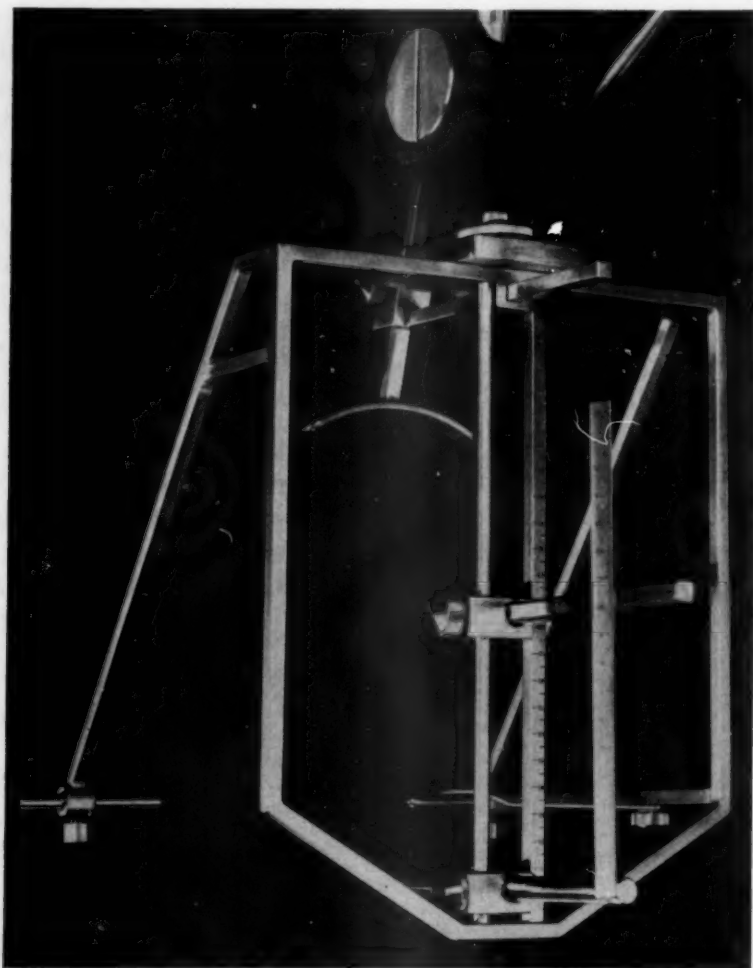


Fig. 1.—The facial orthometer, a simplification of the previous instrument which eliminates computation of readings of facial measurements.

While the dentofacial index may have some future application in the diagnosis and treatment planning phase of orthodontics, it is our intention to use it to measure the incidence and prevalence of dentofacial deformities among large population groups to determine whether there are any geographic or environmental factors which may be responsible for more (or less) malocclusion. Since data upon which to base an index for an individual may be obtained in two minutes or less, the orthometer lends itself well to epidemiologic studies.

The first application of the DFI was to determine the amount of malocclusion of children residing in different communities.<sup>21</sup> In order to insure a known difference between the communities, two were selected, one which had fluorides in the public water and one which had none. Children of the fluoride community, of course, were expected to have about one-third the dental caries of those reared on nonfluoride waters. Fig. 2 represents the difference in the DMF rates and the DFI of 850 children of Coeur d'Alene and Nampa, Idaho. The graph shows the characteristic curves of the dental caries experience of the two groups of children, one of which was exposed to fluoride-

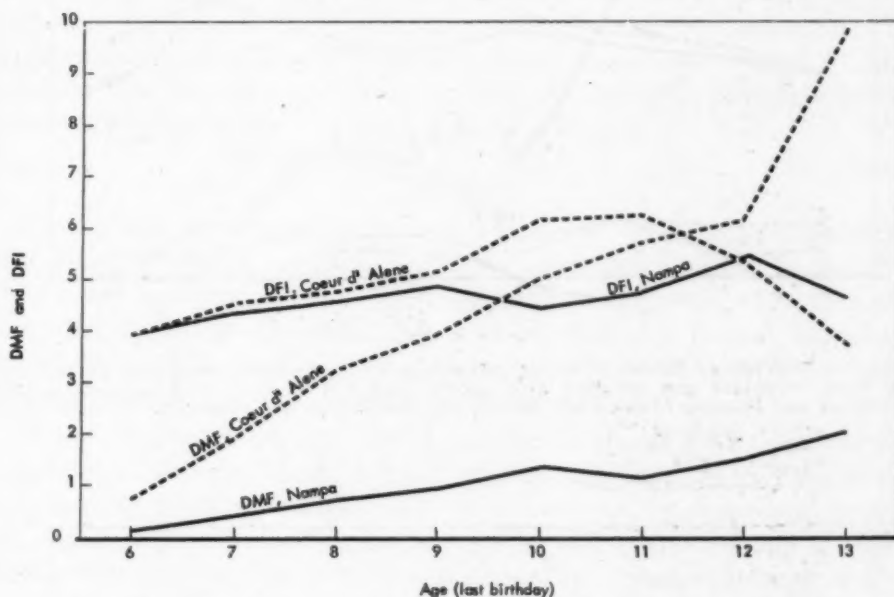


Fig. 2.—Differences in the severity of dental caries attack (DMF permanent teeth) and index of malocclusion (DFI) in 348 and 502 selected white school children of Coeur d'Alene and Nampa, Idaho, respectively. (From Pelton and Elsasser: *J. A. D. A.*, June, 1953.)

free public waters, as in Coeur d'Alene, and one which was exposed to 1.5 ppm fluorides, as in Nampa. (The difference in dental caries experience in this study is 80 to 85 per cent, instead of the 65 per cent usually mentioned.)

Interestingly enough, in Fig. 3 the percentage of children with both cross-bite and crowded arch in the high caries rate city (Coeur d'Alene) at ages 10 and 11 is more than double the percentage showing the same condition in the low caries rate city (Nampa). This fact seems to account for the difference in the DFI between the two groups of children at these ages.

In a well-written summary article which appeared in 1939,<sup>22</sup> the statement was made that "when orthodontics becomes a public health problem, it will be found that much more than 80 per cent of the malocclusion presented for treatment is attributed to lack of care of deciduous teeth." Data from the study cities as shown in Fig. 4 indicate that the missing upper and lower primary second molars are quite different in actual numbers, as well as the peak age when the teeth are lost. This, in turn, reflects the vast difference in caries attack rates between the children of the two communities. On the other

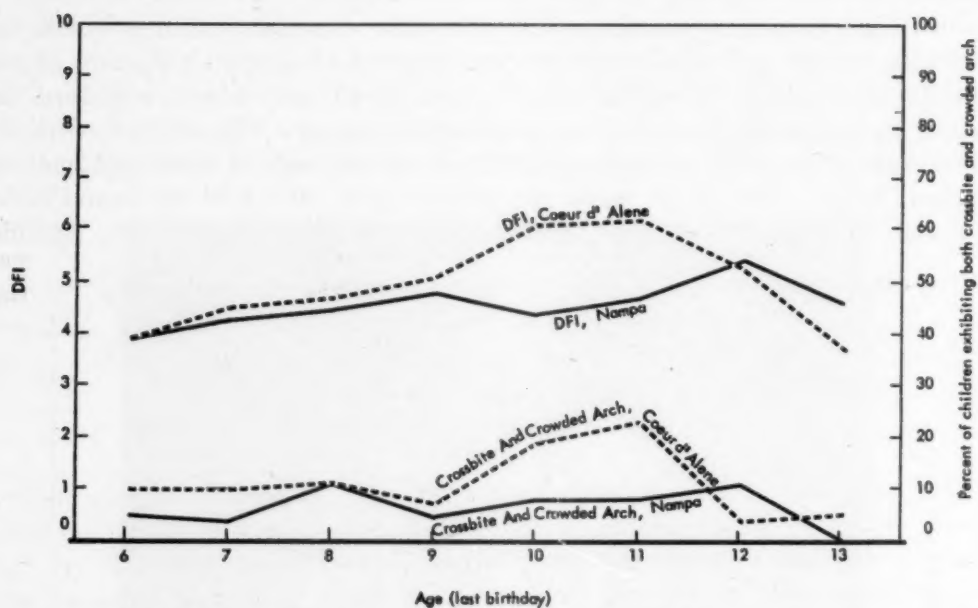


Fig. 3.—Differences in the index of malocclusion (DFI) and percentage of children exhibiting both cross-bite and crowded arch in 348 and 502 selected white school children of Coeur d'Alene and Nampa, Idaho, respectively. (From Pelton and Elsasser: J. A. D. A., June, 1953.)

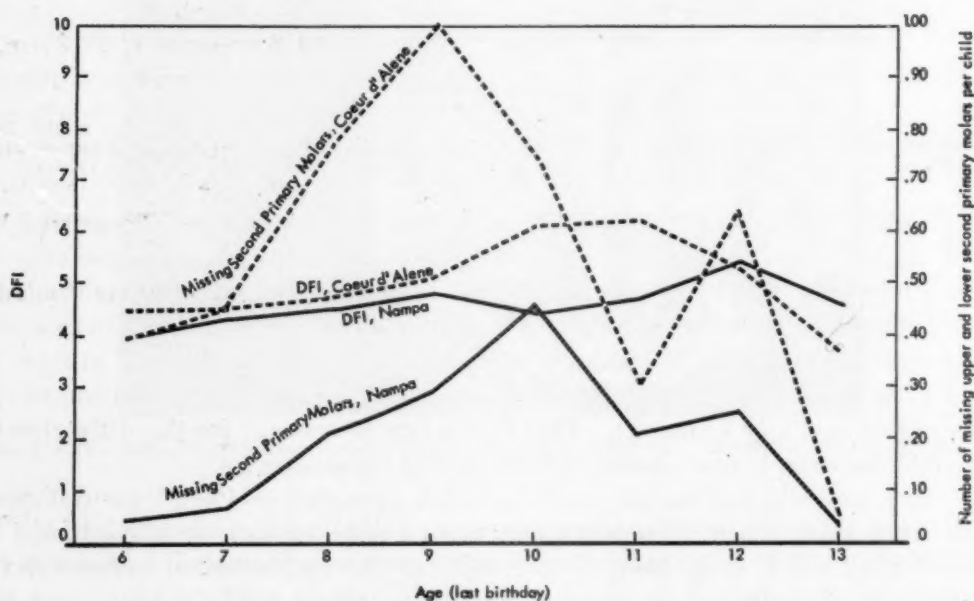


Fig. 4.—Differences in the index of malocclusion (DFI) and the number of missing upper and lower second primary molars per child in 348 and 502 selected white school children of Coeur d'Alene and Nampa, Idaho, respectively. (From Pelton and Elsasser: J. A. D. A., June, 1953.)

hand, the relationship of missing primary second molars to the DFI seems to exhibit the same negative relationship of the DMF rates of permanent teeth to DFI. Because the DFI drops to its earlier level at age 13, the conclusion was drawn, therefore, that the hypothesis assigning dental caries a primary etiologic role in malocclusions is not supported by these data. It is evident that these early findings should be confirmed and it is anticipated that perhaps other and more important facets of the malocclusion problem can be explored and defined. The fact remains that our strides from the "clean-tooth-never-decays" concept to our present knowledge of dental caries prevention was largely dependent upon the concurrent research that took place after dental caries became measurable and could be reduced to statistical terms. Similarly, it is hoped that the DFI will prove to be to orthodontics what the DMF rate has been to dental caries. There is much to be done.

#### SUMMARY

The Federal Government, through a number of programs sponsored by several different official agencies, is making some contributions to the development of orthodontic programs. The contributions may seem unrelated and not very profound, but at the same time it is evolutionary in that remedial programs of a limited nature are supported, and that research, both intramural and extramural, is receiving some financial encouragement.

On the national level there are a number of opportunities for cooperation and leadership which no doubt will benefit the profession, as well as the public. Several specific problems which might be undertaken by orthodontists or their official organizations are: first, the encouragement and promotion of reporting of cleft palate and harelip on birth supplement records in all states as a means of estimating the size of the problem and providing the mechanism to handle it; second, the experimentation with and the promotion of new approaches to handling the orthodontic needs of public beneficiaries; and finally, and perhaps most importantly, the active support of dental research programs from the technical, as well as the financial, point of view.

The coming decade may well be the golden age of orthodontics, as the last decade has been the golden age of dental caries control.

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## DEVELOPMENTAL DISTURBANCES AND MALOCCLUSION OF THE TEETH PRODUCED BY ANDROGEN TREATMENT IN THE MONKEY (*MACACA MULATTA*)

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OF THOSE factors influencing body growth the sex hormones have received little attention as far as dental and maxillofacial development is concerned. Seemingly, there is a far step between the teeth and the gonads, but in recent years evidence has appeared which throws a new and interesting light upon this question. Changes in the developmental time curve and maturation processes markedly influence the relationships of the teeth and jaws.

Estrogens produce a precocious skeletal development and accelerate the osseous unions in the skeleton, thus producing smaller skeletal dimensions (see Steinach and Holzkecht,<sup>19</sup> Spencer, D'Amour, and Gustavson,<sup>18</sup> Zondek,<sup>20-28</sup> Tausk and de Fremery,<sup>20</sup> Gardner and Pfeiffer,<sup>6</sup> and others).

The influence of androgens (male sex hormones), on the other hand, is controversial. Early investigators like Poncet,<sup>13</sup> Richon and Jeandelize,<sup>14, 15</sup> Bouin and Ancel,<sup>3, 4</sup> reported an increased growth in castrates, which should thus imply an inhibitory effect of the male sex hormone comparable to that of the estrogens. However, Steinach<sup>19</sup> and Moore<sup>9-11</sup> obtained a decreased growth of castrates in head size and body weight. Other reports (for example, Webster and Hoskins<sup>25</sup>) give evidence from human material that androgens favor body growth (in hypogonadal men).

E. Kost Shelton<sup>16</sup> reports both an inhibitory and an accelerating effect of testosterone propionate upon growth, explaining that the mechanism is the same as that of adolescence, when, following the normal growth spurt, there is a sharp drop-off and cessation of growth.

According to Silberberg and Silberberg,<sup>17</sup> the maturation of the skeleton might be accelerated or delayed by several substances, such as anterior pituitary extract, thyroid hormone, potassium iodide. It also occurs in such cases that a primary stimulation is followed by a premature cessation of growth. This apparently is the case, even in the present material. Accordingly, there seems to be no principal difference in the action of estrogens and

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The hormone-treated and control monkeys reported upon here were part of an extensive study of endocrinology conducted in the Department of Obstetrics and Gynecology, Yale University School of Medicine, by Dr. G. van Wagenen. This part of the work was carried out in the laboratory of Dr. B. G. Anderson, Yale University School of Medicine, while Dr. C. M. Seipel was visiting research associate in Odontology.

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androgens upon growth, even if (naturally) there are qualitative differences expressing themselves in the molding of the skeletal parts.

The induction of a precocious maturation by way of injecting sex hormone seems to be of special interest for the dentition, because, whereas the teeth are preformed in size, a premature cessation of jaw growth is likely to produce malocclusion and anomalies of the dentition.

In the present material there are remarkable changes of facial growth and occlusion produced by the injection of testosterone propionate in growing male monkeys.

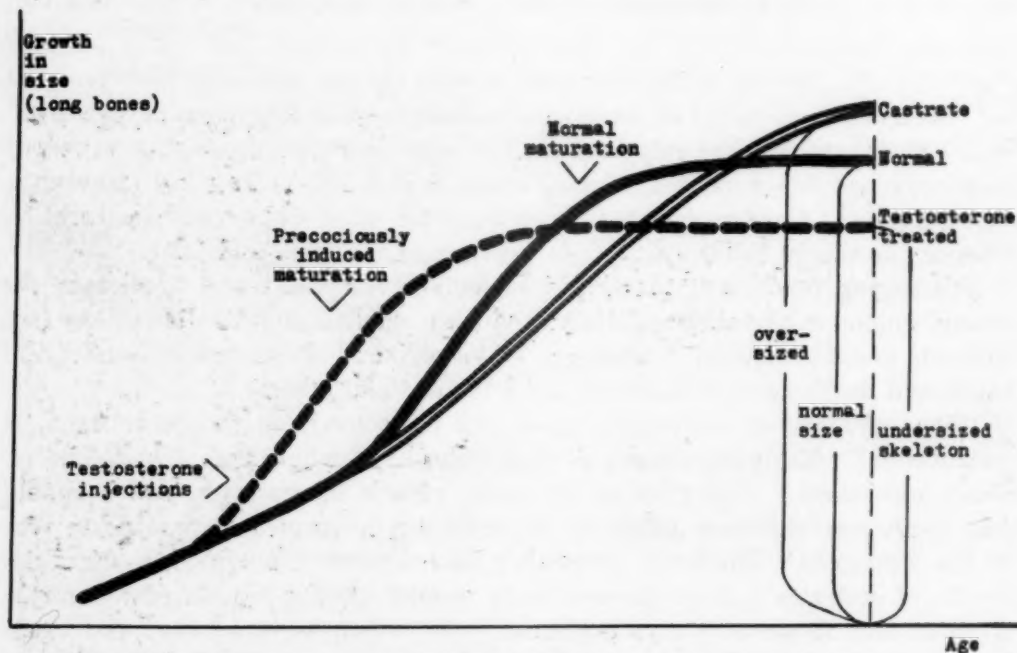


Fig. 1.—Schematic curves of maturation and growth in testosterone-treated, normal, and castrated male monkeys. The precociously induced, as well as the normal, maturation produced a growth spurt, followed by a closure of sutures and cessation of growth. In the castrate this process is lacking and epiphyseal growth goes on for a prolonged period.

The six experimental animals reported upon here belong to a series of rhesus monkeys treated with testosterone propionate for various periods in the monkey colony of the Department of Obstetrics and Gynecology at Yale University Medical School (Dr. G. van Wagenen). Normal age controls of the same homogeneous group were used for assessing the growth changes. Also, some castrates were used for comparison of growth in absence of the gonadal hormone.

The general growth changes in the mature animal appear as a decrease in size of the animals which had received testosterone treatment for a prolonged period during time of growth. In the hormone-treated animals an initial growth spurt following the injections has been observed,<sup>21, 22</sup> but the excess hormone soon produced a precocious maturation (Fig. 1) and early fusion of sutures in the skeleton, the end result being a considerable decrease in skeletal size (Fig. 2). In the castrates, on the other hand, there is a de-

layed closure of sutures with an increase in size especially of the long bones. The course of development in these three groups might be schematically represented as in the curves of Fig. 1.

At the age of 7 years 10 months, which represents full maturity in this species, the epiphyseal lines of the long bones in the castrate were still open in several places, whereas in the normal control animal they were fused, and in the testosterone-treated animal completely obliterated.

Of the treated monkeys, only those that received hormone for a prolonged period during an early age and in large doses (3 to 10 times therapeutic dose for man) showed any remarkable changes. The test animal with the most pronounced changes (No. 622) received semi-weekly injections totaling 7.5 mg. per kilogram of bodyweight from 6 months to 3½ years of age.



Fig. 2.—Comparison of long bones in testosterone-treated, normal, and castrated animals of same age (7 years, 10 months). The femur of 622 shows a still more pronounced reduction than the humerus. The concomitant muscular hypertrophy in the testosterone-treated animal seems to be responsible for the secondary configuration of the skeletal parts, which appear both in the long bones and in the mandible.

The growth of the skull and the jaws is considerably more complicated than that of the long bones, and the experimental changes are not clear-cut as in the long bones. There is a general reduction in size of the testosterone-treated animal, except for transverse skull size, but the castrate's head is also somewhat reduced in size compared to that of the normal control. This latter reduction is in agreement with the observation of Steinach.<sup>19</sup>

The growth of the jaws is tied up with a series of sutural and appositional growth processes. These are apparently modified and arrested in the early maturation of the testosterone-treated animal. There is a marked arrest in

both sagittal and vertical growth of the face. The transverse dimensions of the maxilla are also reduced, but, on the other hand, the zygomatic arch and the transverse skull size are nearly normal (bizygomatic width 92.8 mm. against 92.9 mm. in the control, and transverse skull size 63.2 mm. against 65.4 mm.). The zygomatic arch development apparently is related to the muscular hypertrophy, which is another effect of the precocious maturation. In the castrate, the zygomatic arch is considerably less protruding, which also coincides with the muscular flaccidity and underdevelopment in this case. Functional influences seem to be at work and complicate the picture of facial growth.

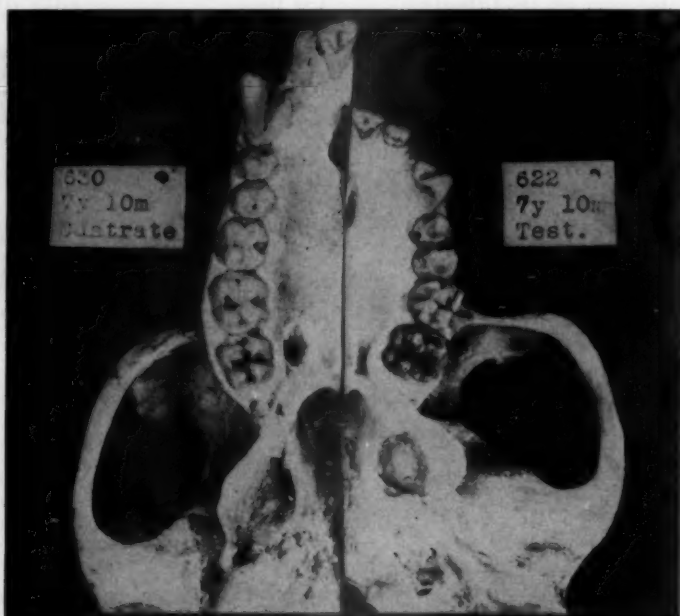


Fig. 3.—Comparison of upper jaws in testosterone-treated (622) and castrated animals (630). The latter is somewhat reduced in palate length against a normal control. The bizygomatic width in No. 622 is the same as in normal control, whereas it is reduced about 6 per cent in No. 630. The zygomatic arch development coincides with the muscular hypertrophy in the testosterone-treated and the flaccidity in the castrated animal.

The inconspicuous change in transverse size of the skull and the zygomatic arch is comparable to the condition found in hypophysectomized rats by Walker, Asling, Simpson, Li, and Evans,<sup>24</sup> where the skull in reduced growth assumes a rounded form, apparently, as just cited, under functional requirements from the growing soft tissues.

The changes of the jaws and dentition in the testosterone-treated animal (No. 622) are so apparent that they may be safely assessed, in spite of the insufficient method of control, through comparison with animals of the same age only. The most prominent changes are a lack of sagittal growth of the jaws, both upper and lower, amounting to a size reduction of 20 to 25 per cent against the normal control (Fig. 3). The vertical height is reduced about the same amount (nasion-prosthion 23.7 per cent). Besides these size reductions,

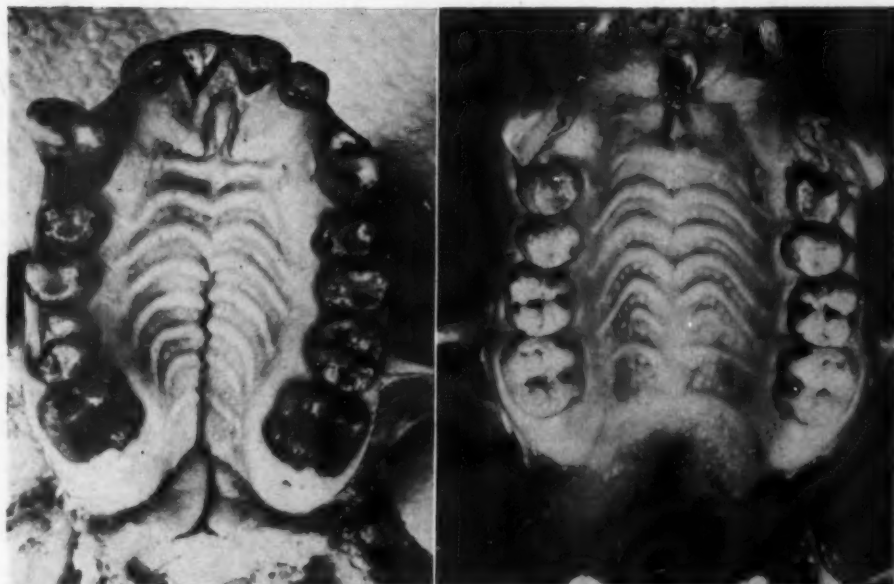


Fig. 4.—Maxillary constriction in testosterone-treated rhesus monkey (622) compared to normal arrangement of the maxillary arch and palate (578). The dental arch is narrowed and the soft palate is wrinkled up in the precociously matured animal (622).

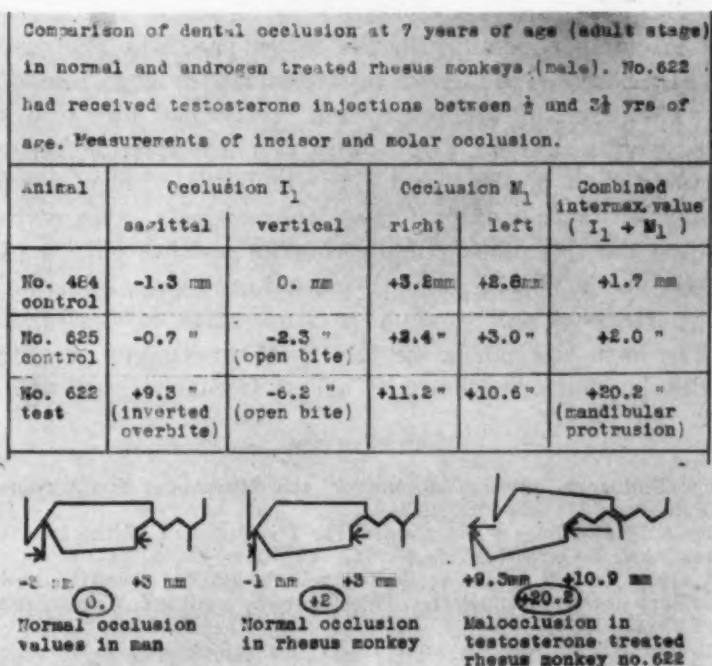


Fig. 5.—Schematic drawings of normal dental occlusion in man and rhesus monkey, compared to the Class III malocclusion in a testosterone-treated rhesus monkey (No. 622).

there are morphologic changes, of both upper and lower jaws, implying functional adaptations of the dwarfed skeleton. These will be taken up in more detail in another publication.

The impairment of skeletal development is most apparent in the maxilla and the palate of animal No. 622. There is no space for the third molars, which are completely impacted against the pterygoid process. The first molar is situated under the zygomatic arch, whereas normally it would be far in front of this suture (Figs. 3 and 4). The soft palate is wrinkled up in deep furrows due to the palatal and pharyngeal constriction under the insufficiency of hard tissue development.

The dentition in the testosterone-treated animals seems to be subjected to the same changes as the skeleton (Fig. 1), namely, following an initial acceleration of tooth eruption<sup>23</sup> there is a marked retardation and cessation of development, appearing in a series of local changes such as (1) lack of alveolar growth, with open-bite tendency; (2) lack of mesial migration of teeth in relation to the alveolarzygomatic crest; (3) delayed eruption and impaction of molar teeth; and, (4) disturbed root development, shortened and crooked roots of the teeth (Fig. 5).

These signs apparently are referable to the precocious maturation, where the dental and alveolar structures are repressed in development. Their time curve cannot be accelerated sufficiently, and they are locked in an incomplete development.

#### CONCLUSION

A Class III malocclusion, with the lower jaw in a protrusive open-bite position, has been observed in the monkeys treated with large doses of testosterone propionate. This shift of occlusion from the normal bite position might be attributed to several causes. First, there is a lesser reduction in size of the mandibular body than of the upper jaw, combined with an arrest of growth in a dorsolateral direction of porion and the articular area of the skull, this tending to give the mandible a more ventral position with a Class III malocclusion of the teeth. Finally, the decreased oral space with the concomitant muscular hypertrophy and tongue pressure also advances the mandible ventrally. The open-bite can be explained by this tongue pressure, as well as by the mandibular malformation with arrest of condylar growth.

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# TREATMENT OF A CLASS II, DIVISION 2 MALOCCLUSION INVOLVING MESIODISTAL REDUCTION OF MANDIBULAR ANTERIOR TEETH

## REPORT OF A CASE

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1. *Title.*—P. K. was a white girl, aged 11 years, 7 months in October, 1948.
2. *Diagnosis.*—She had a Class II, Division 2 malocclusion, with the characteristic deep overbite. The mandibular and maxillary anterior teeth were retracted, the maxillary right lateral incisor overlapped the adjoining central incisor, and the mandibular anterior teeth were in torsion. There was insufficient room in the arch for the erupting left maxillary canine. Both arches showed a loss of arch integrity.
3. *History and General Clinical Picture.*—The patient was an intelligent girl, in good physical condition. Her birth had been normal; childhood diseases included bronchitis and chicken pox. Tonsils and adenoids had been removed. Swallowing, respiration, and speech were normal.
4. *Etiology.*—It is probable that this malocclusion could be attributed to a combination of intrinsic and extrinsic factors. Since facial esthetics were good, with a tendency toward the mesognathic type, the denture pattern may have evolved as a result of inheritance factors. There may have been, also, some early loss of deciduous teeth, resulting in the mesial drift of the buccal segments. The lip musculature was very firm, which could account for the retraction of the anterior segments.

### 5. *Plan of Treatment.*—

#### A. *General plan:*

1. To open the bite.
2. To obtain proper cuspal relationship in the buccal segments.
3. To upright the teeth of both maxillary and mandibular anterior segments.
4. To re-establish the integrity of both dental arches.

B. *Appliances used:* The four first permanent molars were banded, and a maxillary bite plate was inserted. A labial arch wire, 0.040 inch in diameter, was inserted in the mandibular arch, and adjusted to round out the arch and upright the teeth. After the bite had been opened, all the maxillary teeth were banded, carrying edgewise brackets. Sheaths were soldered to the first molar bands. Successive round arch wires, 0.018 and 0.020 inch in diameter, then were employed in the maxillary arch, following which a rectangular arch wire

0.021 inch by 0.025 inch in diameter was inserted, carrying intermaxillary hooks. Class II mechanics then were employed, with strong tip back bends, until proper occlusion of the buccal segments was obtained. During this time, the mandibular anterior teeth, which were excessively wide mesiodistally, were stripped slightly, polished carefully, and banded. Sodium fluoride treatments were administered prior to banding of these teeth. Rotations then were completely removed, while the labial arch wire was firmly adjusted for the Class II elastic action. All appliances and bands were removed in May, 1951.

A.



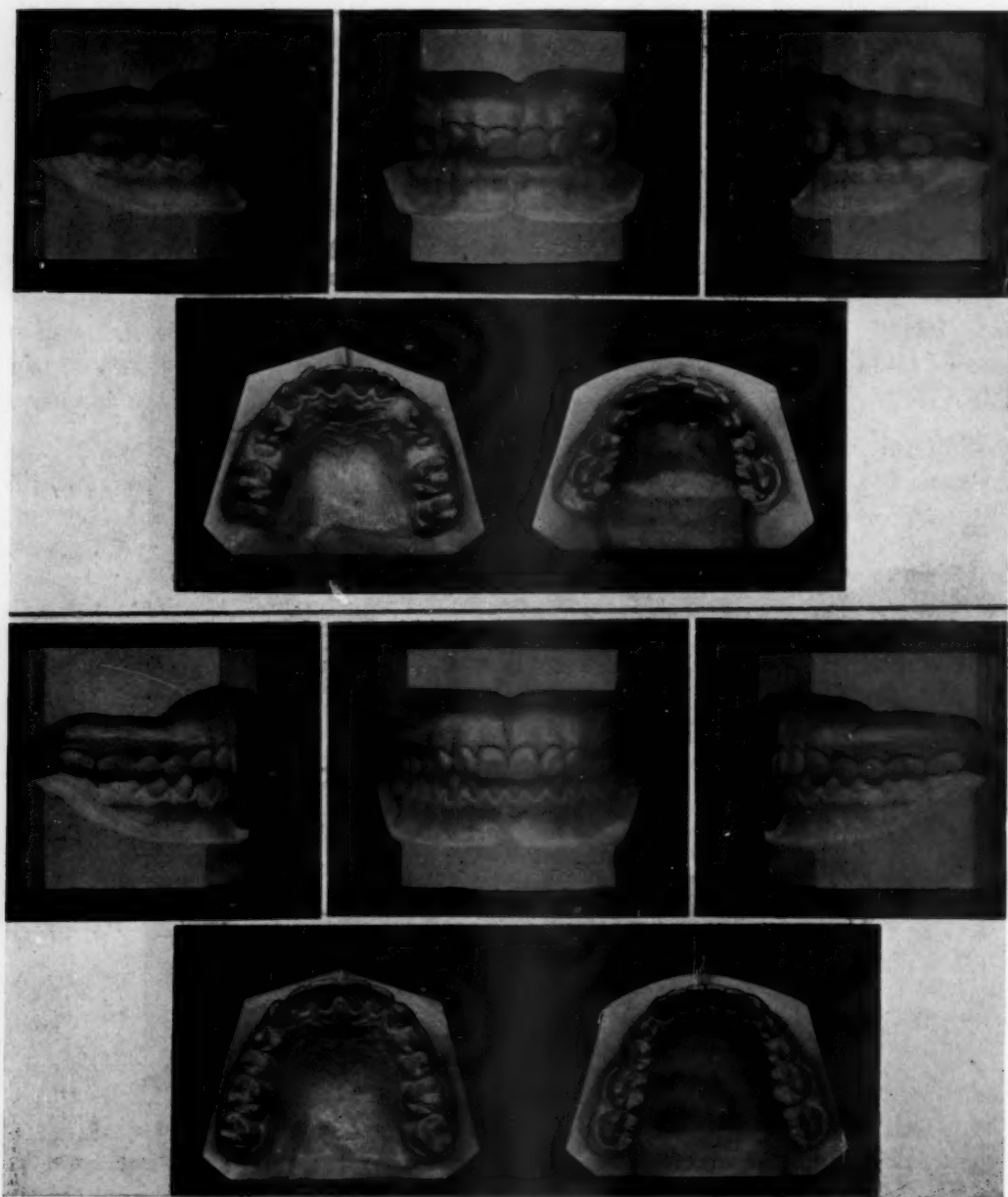
B.

Fig. 1.—P. K. A, Before treatment, 11 years, 7 months; B, after treatment, 14 years, 7 months.

6. *Progress of Case.*—The patient was seen at intervals of three weeks. Cooperation was excellent throughout the entire period of treatment. This case was treated for a somewhat lengthy period, due to the fact that the patient had a high caries attack rate, and the appliances were removed frequently for operative care.

7. *Secondary Treatment.*—Maxillary and mandibular Hawley retainers were constructed in May, 1951, and were worn continuously for a period of seven months. Their use was discontinued for an observation period of several weeks, and they then were discarded.

A.



B.

Fig. 2.—P. K., casts. A, Before treatment; B, after treatment. Contrast the excessively wide mandibular anterior teeth in the occlusal view (A) with the occlusal view after treatment.

8. *Results Achieved.*—Esthetically and functionally, treatment of this case seems to have fulfilled the treatment objectives (Figs. 1 and 2).

9. *Observations and Conclusions.*—This case was brought to a successful conclusion largely by virtue of the fact that the skeletal framework was adequately proportioned, and the cooperation of the patient was excellent. Tracings were made of the original and completed cephalometric roentgenograms, superposed, showing the changes in the sagittal outline (Fig. 3). The analysis showing the changes and comparison with the mean values established by Downs and Reidel is shown in Table I.

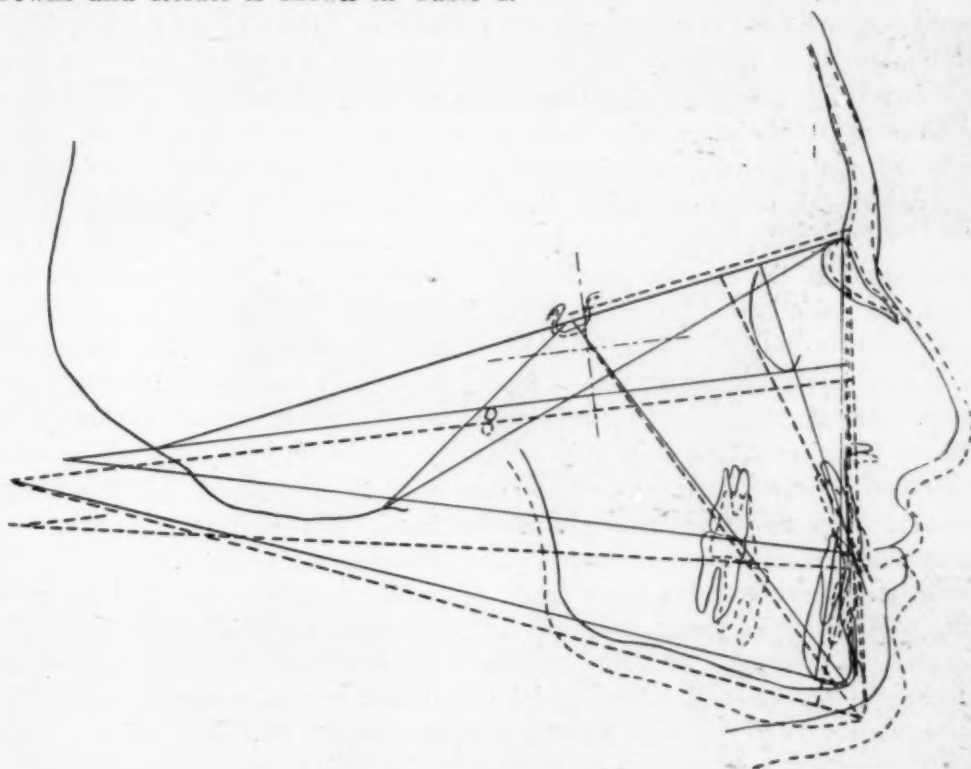


Fig. 3.—Superposed tracings of cephalometric roentgenograms. Solid line, before treatment; broken line, after treatment.

TABLE I

CEPHALOMETRIC ANALYSIS			CHANGES	CONTROL GROUP (MEAN)	
DATE	OCT. 15, 1948	OCT. 22, 1951			
Facial angle	84.5	86.0	+1.5	85.33	(Reidel)
Angle S-N-A	74.0	73.0	-1.0	80.79	(Reidel)
Angle S-N-B	73.0	74.0	+1.0	78.02	(Reidel)
Difference	-1.0	+1.0		+2.77	(Reidel)
Angle of convexity	-1.5	-3.0	-1.5	+4.22	(Reidel)
Mandibular plane angle	20.0	22.0	+2.0	27.06	(Reidel)
Y axis angle	58.5	60.0	+1.5	59.4	(Downs)
Angle $\overline{1}$ to $\overline{1}$	152.0	138.5	-13.5	130.40	(Reidel)
Angle $\overline{1}$ to mandibular plane	85.5	90.0	+4.5	93.52	(Reidel)
Angle $\overline{1}$ to occlusal plane	87.5	78.5	-9.0	71.79	(Reidel)
$\overline{1}$ to facial plane	2 mm.	2 mm.	0.0	6.35 mm.	(Reidel)
Angle $\overline{1}$ to NS	92.0	99.0	+7.0	103.54	(Reidel)
Cant of occlusal plane	+13.0	+10.0	-3.0	+9.3	(Downs)

The facial angle of 84.5 degrees, and the angle of convexity of 1.5 degrees (read in minus degrees, as in this case, constituting an angle of concavity) indicate that we are dealing here with a facial type tending toward the mesognathic. Certainly the denture pattern, as expressed in the last six figures of the analysis, shows a marked retraction of the anterior segments. In this type of case it is necessary that the malocclusion be corrected without adversely affecting facial esthetics, or violating muscular balance. We may observe in the changes that have taken place, as expressed in angles  $\overline{1}$  to  $\underline{1}$  and  $\overline{1}$  to mandibular plane, that the teeth have been markedly uprighted, resulting in an improved facial pattern. Apart from accretionary growth, there has been a repositioning of the mandible. This is evidenced by the increase in the facial angle, the relative changes in the difference of S-N-A and S-N-B, and the angle of convexity, all of which denote that there has been a forward swing of the chin. Comparison of the two tracings shows an increase in the denture height, measuring from the anterior nasal spine to gnathion, and a lowering in the cant of the occlusal plane. These are all factors which contributed to the change in the denture pattern, consistent with esthetic requirements. The opening of the Y axis angle indicates that vertical growth is proceeding somewhat faster than horizontal growth, but is within normal limits. Stripping of the mandibular anterior teeth, resorted to in this case, was justifiable and required in order to remove rotations and place them correctly in a position consistent with muscular balance. Measurements of the mandibular central and lateral incisors, mesiodistally, were 5.5 and 6.5 mm., respectively, before treatment. The average measurements for these teeth, according to tables compiled by G. V. Black,<sup>1</sup> are 5.4 and 5.9 mm., respectively. For small teeth, his figure is 5.0 mm. for each. After stripping, the combined diameters of the four mandibular anterior teeth totaled 21.0 mm., which is 3.0 mm. less than the original, and a figure more in harmony with the measurements of the maxillary anterior teeth, which were on the small side, according to Black's tables.

10. *Posttreatment Findings.*—The patient has been under periodic surveillance since completion of treatment, and there has been essentially no change. The third molars are coming into position, but there is a possibility that those in the maxilla may not have sufficient room, in which event the later removal of all third molars may be required. Root resorption was of slight degree, and confined to the anterior teeth, as disclosed by intraoral roentgenograms, but there is no mobility of any teeth (Fig. 4). The gingival tissues are in excellent condition as of this date.

In conclusion, may I say that we in orthodontics have indeed traveled a long and not always rose-strewn path since the days of Angle. Most of us, I believe, have come to a sharp bend in that path, and have paused there to reflect that the sanctity of the human tooth is a dictum to which we cannot always adhere. Life itself is compromise, and if, in the attainment of all our objectives in orthodontics, something must be changed or sacrificed, we should have no compunction in making an honorable compromise. We therefore order

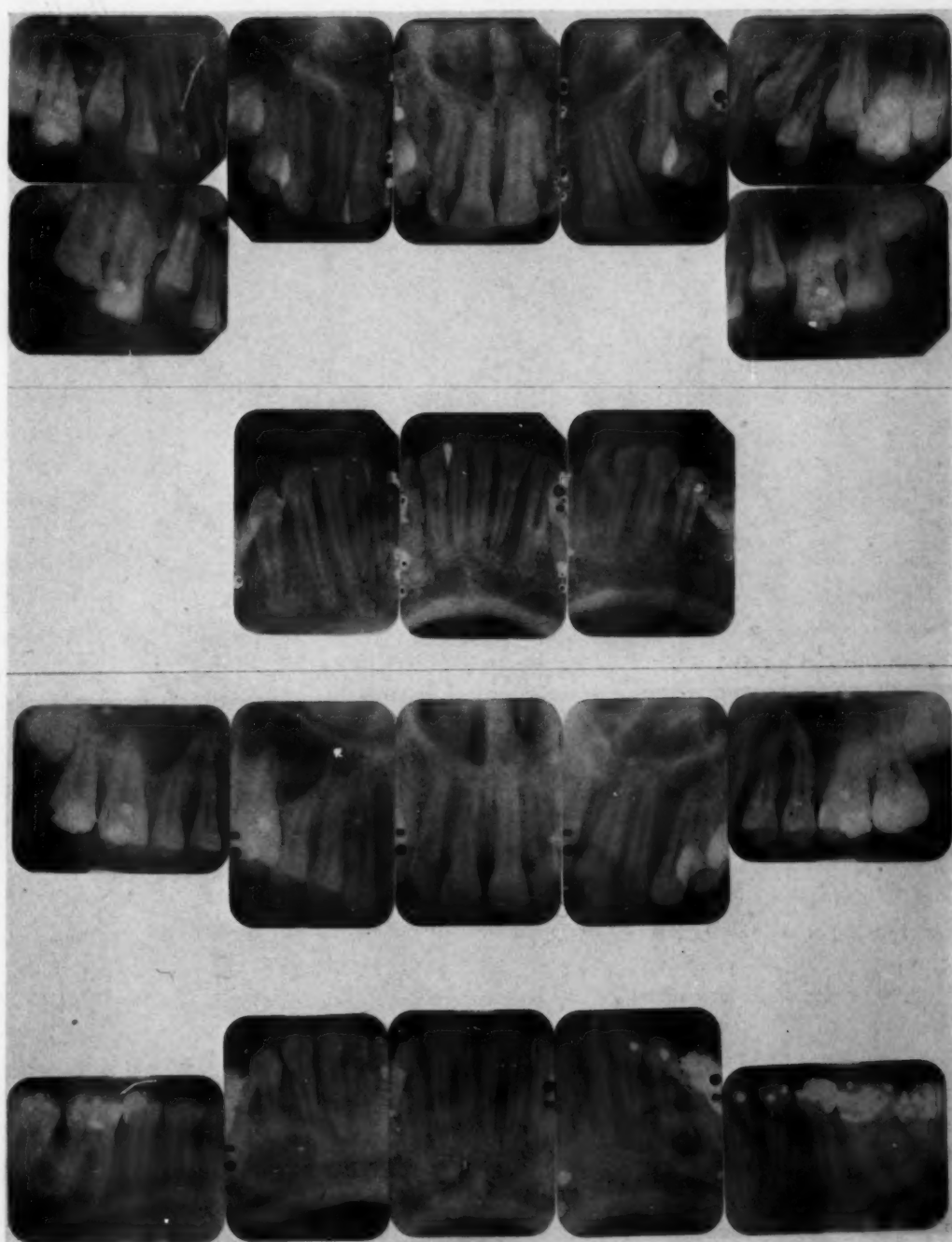


Fig. 4.—P. K., intraoral roentgenograms. A, Before treatment; B, after treatment. Note reduction in mesiodistal diameter of mandibular anterior teeth.

teeth removed; very often, especially when there is a disharmony in size of opposing teeth, we have restorations made to close spaces and restore contacts; we reshape teeth in order that good occlusion may be established.

Dr. Edward Fischer, at our last meeting in Montreal, told us, among other things, of the necessity for reducing the mesiodistal diameter of teeth to eliminate crowding, which, if uncorrected, may result in periodontal involvements. Since, in a prophylactic sense, this is one of our major objectives, I was motivated to present this case report. Its rationale demonstrates another procedure in technique too readily overlooked by those ephemeral perfectionists, who, in their unyielding rejection of compromise, too often in reality find themselves straining after gnats.

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## CEPHALOMETRIC STANDARDS FOR CHILDREN 4 TO 8 YEARS OF AGE\*

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IN MARCH of 1946 a program designated as the Facial Growth Study was initiated at the State University of Iowa under the direction of Howard V. Meredith and L. B. Higley and sponsored jointly by the Iowa Child Welfare Research Station and the College of Dentistry. Although the study is called "Facial Growth," numerous trunk and limb measurements are procured in addition to those taken of the head and face. Also height, weight, dietary information, and illness history data are included among materials gathered at each appointment. Dental casts, anterior and profile photographs, and full intraoral roentgenograms are secured twice each year, while postero-anterior and profile cephalograms are taken at three-month intervals until age 5 and twice yearly after the children reach the fifth birthday.

A total of eighty-nine boys and eighty-six girls have been included in the study, with an active participation of seventy-three boys and seventy-five girls most of the time. Some were started as early as 3 years of age. The appointments are scheduled on, or within five days of, the child's birthday and the same plan is followed for the other visits.

Ninety-seven per cent of the children used in this study are of northern European ancestry and all of the subjects possess clinically acceptable occlusions, with the dentures appearing to be well oriented with respect to the face. Approximately one-half of these children are from families in the professional field and the other half from managerial, commercial, or skilled trades families. All reside in or around Iowa City, Iowa.

Some of the accumulated data have been analyzed and the findings previously reported.<sup>1-3</sup> This report will summarize in table form the mean, standard deviation, standard error of the mean, and the range for seventeen linear and twenty angular measurements determined from oriented profile roentgenograms of twenty-five to thirty boys and an equal number of girls from the fourth through the eighth year. These values may be considered as cephalometric standards for North American white children of northern European ancestry. As may be seen, less than one-half of the available profile roentgenograms have been analyzed for this report, but the rest will be as time permits.

\*This report is a compilation of data procured as part of the requirements for a Master's degree in the College of Dentistry of the State University of Iowa by the following graduate students: Robert H. Ervin, Robert M. Nelson, Robert C. Geiger, Richard G. Wagner, Robert E. Sprott, David J. Carstensen, William P. Kotteman, Marion L. Kercheval, and Wilbur R. Sanders.

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TABLE I. LINEAR MEASUREMENTS: TAKEN FROM PROFILE ROENTGENOGRAMS ACCUMULATED IN THE STATE UNIVERSITY OF IOWA FACIAL GROWTH STUDY

AGE (YEARS)	BOYS					GIRLS				
	N	MEAN	S.E.M.*	S.D.†	RANGE	N	MEAN	S.E.M.*	S.D.†	RANGE
<i>Quadrilateral NMGZ Anterior Side (NM)</i>										
4	25	97.7	0.76	3.7	89.0 to 103.0	25	96.1	0.80	3.9	89.0 to 104.0
5	30	100.5	0.70	3.8	91.5 to 106.5	30	97.5	0.80	4.3	90.0 to 107.0
6	26	104.4	0.88	4.4	97.0 to 112.0	21	101.6	0.93	4.2	95.0 to 110.0
7	30	106.9	1.01	5.4	93.5 to 116.5	30	104.1	0.85	4.6	95.5 to 112.0
8	31	108.1	0.84	4.6	100.0 to 119.0	29	104.5	0.86	4.6	98.0 to 116.0
<i>Quadrilateral NMGZ Inferior Side (MG)</i>										
4	25	63.3	0.68	3.3	53.5 to 70.0	25	61.3	0.61	3.0	56.0 to 67.0
5	30	65.1	0.56	3.0	57.0 to 71.0	30	62.9	0.61	3.3	57.0 to 69.0
6	26	69.9	0.79	4.0	59.0 to 76.0	21	67.6	0.55	2.4	63.0 to 72.0
7	30	70.5	0.64	3.5	62.0 to 78.5	30	68.7	0.63	3.4	63.0 to 75.0
8	31	72.2	0.83	4.5	60.5 to 80.5	29	69.1	0.64	3.4	64.5 to 77.5
<i>Quadrilateral NMGZ Posterior Side (GZ)</i>										
4	25	59.7	0.75	3.7	53.0 to 68.5	25	55.1	0.65	3.2	48.0 to 63.0
5	30	61.8	0.58	3.1	79.0 to 93.0	30	57.0	0.65	3.5	50.0 to 66.0
6	26	64.0	0.95	4.7	56.5 to 75.0	21	59.5	1.98	8.9	53.0 to 67.0
7	30	64.0	0.67	3.6	55.0 to 69.0	30	59.2	0.77	4.2	54.0 to 66.0
8	31	66.3	0.84	4.6	56.0 to 76.5	29	61.6	0.81	4.3	50.0 to 71.0
<i>Quadrilateral NMGZ Superior Side (NZ)</i>										
4	25	77.8	0.69	3.4	73.5 to 90.0	25	74.9	0.91	4.5	65.0 to 83.0
5	30	84.7	0.63	3.4	79.0 to 93.0	30	79.7	0.88	4.7	70.5 to 88.5
6	26	80.5	1.19	5.9	61.5 to 92.0	21	79.2	1.03	4.6	72.0 to 90.0
7	30	86.4	0.93	3.9	79.0 to 95.0	30	82.8	0.76	4.1	75.0 to 91.5
8	31	88.7	0.77	4.2	80.5 to 97.0	29	82.8	0.92	4.9	74.0 to 92.5
<i>Quadrilateral FMGT Anterior Side (FM)</i>										
5	30	74.3	0.73	3.9	66.5 to 84.0	30	72.9	0.64	3.5	67.0 to 83.0
6	30	76.9	0.68	3.7	70.0 to 83.0	30	75.1	0.72	3.9	68.0 to 84.0
7	30	79.2	1.04	5.6	65.0 to 90.0	30	77.2	0.70	3.8	71.0 to 84.5
8	31	82.1	0.72	4.0	74.0 to 92.0	29	81.1	0.70	3.7	73.5 to 88.5
<i>Quadrilateral FMGT Posterior Side (GT)</i>										
4	25	43.7	0.78	3.8	32.5 to 49.5	25	40.7	0.67	3.3	37.0 to 47.0
5	30	47.0	0.70	3.8	41.0 to 53.5	30	44.7	0.70	3.8	36.0 to 52.5
6	26	46.9	1.00	5.0	38.0 to 55.0	21	43.0	0.60	2.7	38.0 to 48.0
7	30	47.1	0.67	3.6	38.0 to 51.0	30	44.8	0.70	3.8	40.0 to 57.5
8	31	49.1	0.80	4.4	40.0 to 59.5	29	47.0	0.78	4.1	37.0 to 58.5
<i>Quadrilateral FMGT Superior Side (FT)</i>										
4	25	71.7	0.59	2.9	68.0 to 76.0	25	68.8	0.72	3.6	59.5 to 76.0
5	30	77.6	0.51	2.8	73.5 to 85.0	30	73.7	0.72	3.9	66.0 to 81.0
6	26	77.1	0.66	3.3	73.0 to 84.0	21	73.7	0.76	3.4	69.0 to 80.0
7	30	79.7	0.58	3.1	74.0 to 86.5	30	76.2	0.66	3.6	71.5 to 83.0
8	31	82.4	0.66	3.6	72.5 to 89.0	29	77.0	0.74	3.9	70.0 to 85.0
<i>Distance N to S (NS)</i>										
4	25	64.2	0.50	2.5	58.5 to 68.5	25	62.7	0.52	2.6	57.5 to 68.0
5	30	65.3	0.41	2.2	59.0 to 68.5	30	62.9	0.44	2.4	58.0 to 68.5
6	26	67.1	0.51	2.6	61.5 to 70.0	21	64.7	0.62	2.8	60.0 to 71.0
7	30	67.7	0.48	2.6	63.5 to 71.5	30	66.0	0.42	2.3	61.5 to 71.0
8	31	68.5	0.60	3.3	60.0 to 76.0	29	65.7	0.50	2.7	60.5 to 71.0
<i>Distance N to Bp (NBp)</i>										
4	25	113.9	0.76	3.7	107.0 to 123.5	25	110.5	0.90	4.4	97.5 to 118.0
5	25	116.7	0.76	3.7	108.0 to 123.0	25	112.9	0.80	3.9	103.0 to 120.0
6	26	124.0	1.14	5.7	117.0 to 140.0	21	117.0	0.25	11.3	77.0 to 130.0
7	30	121.7	0.74	4.0	113.5 to 129.0	30	116.7	0.68	3.7	110.0 to 126.0
8	31	124.7	0.88	4.8	116.0 to 136.0	29	117.4	0.74	3.9	110.5 to 127.5

AGE (YEARS)	BOYS					GIRLS				
	N	MEAN	S.E.M.*	S.D.†	RANGE	N	MEAN	S.E.M.*	S.D.†	RANGE
<i>Distance S to Bp (SBp)</i>										
4	25	55.0	0.42	2.1	50.0 to 58.5	25	52.7	0.68	3.3	41.5 to 59.0
5	25	55.6	0.42	2.1	53.0 to 61.0	25	53.5	0.67	3.3	41.0 to 57.0
6	26	60.2	0.85	4.2	54.0 to 75.0	21	58.4	0.85	3.8	52.0 to 67.0
7	30	59.4	0.48	2.6	54.5 to 65.0	30	56.2	0.42	2.3	50.0 to 60.5
8	31	61.8	0.73	4.0	56.5 to 75.0	29	57.6	0.63	3.3	51.5 to 69.5
<i>Distance S to M (SM)</i>										
4	25	106.8	1.17	5.7	93.5 to 114.0	25	99.5	0.79	3.9	91.5 to 106.0
5	25	108.5	0.94	4.6	97.0 to 117.0	25	102.6	0.79	3.9	95.0 to 112.0
6	26	111.4	1.02	5.1	100.0 to 112.0	21	105.3	0.74	3.3	98.0 to 112.0
7	30	113.5	0.85	4.6	103.5 to 124.0	30	108.0	0.82	4.4	100.0 to 116.0
8	31	115.3	0.32	5.5	104.0 to 129.0	29	110.7	0.82	4.3	102.5 to 119.5
<i>Distance Labial Surface Mandibular Incisors to Line M<sub>1</sub>M<sub>2</sub>(I)</i>										
4	25	4.9	0.42	2.1	2.0 to 9.5	25	4.9	0.38	1.9	2.0 to 8.0
5	25	5.0	0.38	1.9	2.0 to 8.0	25	4.1	0.34	1.7	1.5 to 7.0
6	26	6.2	0.48	2.4	2.0 to 10.0	21	5.1	0.53	2.4	1.0 to 10.0
7	30	5.7	0.44	2.4	2.0 to 10.0	30	5.2	0.36	1.9	0.1 to 9.0
8	31	5.4	0.55	2.9	0.1 to 11.5	29	6.3	0.43	2.3	1.5 to 11.0
<i>Distance Ar' to S' Projected to the Frankfort Plane (Ar'S')</i>										
5	30	12.9	0.50	2.7	5.0 to 18.0	30	12.1	0.45	2.4	8.0 to 17.0
6	30	12.7	0.41	2.2	8.0 to 17.0	30	12.3	0.51	2.7	9.0 to 21.0
7	30	13.7	0.28	1.5	7.0 to 18.0	30	12.5	0.48	2.6	7.5 to 19.0
8	31	15.3	0.49	2.7	8.0 to 20.0	29	13.3	0.53	2.8	8.5 to 19.0
<i>Distance Ptm to S' Projected to the Frankfort Plane (PtmS')</i>										
5	30	18.3	0.40	2.1	13.0 to 23.0	30	17.2	0.31	1.7	14.0 to 21.0
6	30	18.5	0.36	1.9	13.0 to 22.0	30	17.5	0.37	2.0	13.0 to 22.0
7	30	18.9	0.45	2.4	14.0 to 25.5	30	18.1	0.35	1.9	15.0 to 23.0
8	31	17.3	0.45	2.5	10.5 to 22.5	29	17.4	0.41	2.6	12.5 to 21.5
<i>Distance Ptm to N' Projected to the Frankfort Plane (PtmN')</i>										
5	30	46.4	0.50	2.7	40.0 to 52.0	30	45.1	0.41	2.2	39.5 to 48.5
6	30	48.1	0.46	2.5	43.0 to 54.0	30	46.3	0.45	2.4	40.0 to 50.5
7	30	48.2	0.58	3.2	43.5 to 55.0	30	47.2	0.43	2.4	42.5 to 52.5
8	31	51.4	0.58	3.2	41.5 to 58.0	29	47.8	0.49	1.7	42.5 to 52.0
<i>Distance Ptm to 6 Projected to the Frankfort Plane (Ptm6)</i>										
5	30	15.5	0.35	1.9	12.0 to 18.5	30	14.6	0.34	1.8	10.0 to 18.0
6	30	13.7	0.40	2.6	9.0 to 18.0	30	11.8	0.40	2.2	7.5 to 16.5
7	30	13.0	0.43	2.3	6.0 to 16.5	30	12.8	0.27	1.4	10.5 to 16.5
8	31	12.0	0.40	2.2	7.5 to 16.5	29	10.9	0.32	1.7	7.0 to 14.0
<i>Distance M<sub>1</sub> to M<sub>2</sub> or Over-All Mandibular Length (M<sub>1</sub>M<sub>2</sub>)</i>										
5	30	87.5	0.64	3.4	78.0 to 93.0	30	83.1	0.61	3.3	77.0 to 90.0
6	30	89.1	0.71	3.8	81.0 to 97.0	30	84.8	0.67	3.6	78.0 to 92.5
7	30	91.9	0.70	3.8	86.0 to 101.0	30	87.8	0.69	3.7	81.0 to 95.0
8	31	93.4	0.71	3.9	84.5 to 100.5	29	89.3	0.75	4.0	83.0 to 97.5

\*S.E.M. Standard error of the mean.

†S.D. Standard deviation of the sample.

TABLE II. ANGULAR MEASUREMENTS: TAKEN FROM PROFILE ROENTGENOGRAMS ACCUMULATED IN THE STATE UNIVERSITY OF IOWA FACIAL GROWTH STUDY

AGE (YEARS)	BOYS					GIRLS				
	N	MEAN	S.E.M.*	S.D.†	RANGE	N	MEAN	S.E.M.*	S.D.†	RANGE
<i>Quadrilateral NMGZ Angle at Gonion (MGZ)</i>										
4	25	128.0	0.92	4.5	118.0 to 137.0	25	128.8	0.92	4.5	121.0 to 141.0
5	25	125.2	1.07	5.2	117.0 to 138.0	25	124.0	1.34	6.6	114.0 to 138.0
6	26	126.0	1.15	5.7	117.5 to 141.5	21	124.9	0.91	4.1	116.0 to 136.0
7	25	126.8	0.92	4.5	118.0 to 133.0	25	128.4	1.15	5.6	118.0 to 139.5
8	25	127.2	0.96	4.7	120.0 to 134.5	25	128.7	1.16	5.7	115.5 to 139.0
<i>Quadrilateral NMGZ Angle at Menton (NMG)</i>										
4	25	68.8	0.69	3.4	61.0 to 74.0	25	67.8	0.51	2.5	63.0 to 71.0
5	25	68.5	0.70	3.4	61.0 to 74.0	25	69.8	0.73	3.6	62.0 to 78.0
6	26	68.3	0.67	3.3	62.0 to 73.0	21	69.1	0.90	4.0	63.0 to 78.0
7	25	69.7	0.56	2.7	65.0 to 74.5	25	67.9	0.63	3.1	61.5 to 73.0
8	25	69.5	0.61	3.0	63.0 to 77.0	25	67.0	0.24	1.2	60.0 to 72.0
<i>Quadrilateral NMGZ Angle at Nasion (MNS)</i>										
4	25	76.4	0.69	3.4	71.0 to 82.0	25	74.4	0.77	3.8	65.0 to 82.0
5	25	77.8	0.81	4.0	73.0 to 84.0	25	75.8	0.58	2.8	69.0 to 81.0
6	26	78.3	0.72	3.6	72.0 to 85.0	21	74.6	0.53	2.4	69.0 to 80.0
7	25	77.1	0.60	2.9	72.0 to 84.0	25	75.5	0.57	2.8	70.5 to 81.0
8	25	77.4	0.69	3.4	72.0 to 86.0	25	76.0	0.57	2.8	71.0 to 83.0
<i>Quadrilateral NMGZ Angle at Point Z (GZN)</i>										
4	25	87.0	0.81	4.0	78.5 to 94.0	25	89.0	1.02	5.0	79.5 to 98.5
5	25	88.8	0.90	4.4	79.0 to 100.0	25	90.9	1.02	5.0	80.0 to 101.0
6	26	87.8	1.02	5.1	74.5 to 97.0	21	91.9	0.96	4.3	83.0 to 97.0
7	25	86.4	0.81	4.0	80.0 to 94.0	25	88.2	0.97	4.7	76.5 to 94.5
8	25	86.4	0.81	4.0	78.0 to 92.0	25	89.0	1.16	5.7	78.0 to 99.0
<i>Quadrilateral FMGT Angle at Point F (MFT)</i>										
4	25	83.9	0.62	3.0	79.0 to 89.0	25	84.3	0.73	3.6	77.5 to 90.0
5	25	84.3	0.67	3.3	78.0 to 91.0	25	83.1	0.66	3.3	77.0 to 90.0
6	26	85.1	0.59	3.0	81.5 to 91.0	21	83.1	0.83	3.7	79.0 to 90.0
7	25	83.3	0.46	2.2	80.0 to 88.0	25	83.8	0.58	2.8	78.5 to 90.0
8	25	82.5	0.61	3.0	77.0 to 88.0	25	82.3	0.64	3.1	72.5 to 88.0
<i>Quadrilateral FMGT Angle at Point T (FTG)</i>										
4	25	79.4	0.95	4.7	70.0 to 90.5	25	79.5	1.02	5.0	71.5 to 89.0
5	25	82.0	0.86	4.2	73.0 to 91.0	25	83.8	1.20	5.9	70.0 to 94.0
6	26	80.5	0.96	4.8	70.0 to 90.0	21	83.2	1.11	5.0	73.0 to 91.0
7	25	80.2	0.75	3.7	73.5 to 86.5	25	80.0	0.98	4.8	72.5 to 91.5
8	25	81.3	0.77	3.8	73.0 to 90.0	25	82.1	0.85	4.2	75.0 to 93.0
<i>Angle at Junction of Facial and Bolton Planes (MNBp)</i>										
4	25	60.3	0.32	1.6	57.0 to 64.0	25	59.0	0.55	2.7	53.0 to 64.0
5	25	62.0	0.37	1.8	58.0 to 65.0	25	60.2	0.52	2.5	56.0 to 66.0
6	26	61.8	0.41	2.0	57.0 to 66.0	21	59.9	0.53	2.4	55.0 to 69.0
7	25	61.2	0.40	1.9	58.0 to 65.5	25	59.9	0.49	2.4	55.5 to 64.5
8	25	61.0	0.57	2.8	52.0 to 65.0	25	59.2	0.53	2.6	54.0 to 64.0
<i>Angle at Junction of Y Axis and Sella Nasion Plane (NSM)</i>										
4	25	66.6	0.60	3.0	62.0 to 71.0	25	68.1	0.66	3.2	61.0 to 76.5
5	25	65.9	0.58	2.9	62.0 to 71.0	25	67.5	0.51	2.5	61.0 to 72.0
6	26	66.0	0.58	2.9	60.5 to 71.0	21	69.0	0.66	2.9	62.0 to 74.0
7	25	67.1	0.56	2.8	62.0 to 72.0	25	68.3	0.54	2.7	64.0 to 73.5
8	25	67.1	0.60	3.0	61.5 to 73.0	25	69.5	0.78	3.8	63.0 to 84.0
<i>Angle at Junction of Y Axis and Frankfort Plane (MDF)</i>										
4	25	59.4	0.71	3.5	54.0 to 68.0	25	58.7	0.71	3.5	62.0 to 65.0
5	25	59.4	0.70	3.5	54.0 to 67.0	25	60.0	0.63	3.1	54.0 to 67.0
6	26	58.8	0.58	2.9	50.0 to 62.5	21	60.5	1.00	4.5	54.0 to 73.0
7	25	60.8	0.45	2.2	56.5 to 65.0	25	59.9	0.53	2.6	53.5 to 66.0
8	25	61.9	0.59	2.9	55.0 to 68.0	25	62.3	0.76	3.7	57.5 to 72.5
<i>Angle at Junction of Mandibular and Bolton Planes (MXN)</i>										
4	25	50.9	0.73	3.6	46.0 to 57.0	25	53.1	0.76	3.7	47.0 to 58.0
5	25	49.9	0.76	3.7	43.0 to 57.0	25	51.0	0.80	3.9	42.0 to 57.0
6	26	50.4	0.69	3.4	44.0 to 56.0	21	53.1	1.05	4.7	46.0 to 61.0
7	25	49.1	0.72	3.5	41.0 to 55.5	25	52.1	0.80	3.9	45.0 to 59.5
8	25	49.3	0.90	4.4	40.0 to 59.5	25	53.4	0.69	3.4	46.0 to 60.0

AGE (YEARS)	BOYS					GIRLS				
	N	MEAN	S.E.M.*	S.D.†	RANGE	N	MEAN	S.E.M.*	S.D.†	RANGE
<i>Angle at Junction of Frankfort and Mandibular Planes (F to M)</i>										
4	25	28.2	0.98	4.8	20.0 to 41.0	25	27.9	0.87	4.3	19.5 to 35.0
5	25	27.1	0.91	4.5	18.0 to 36.0	25	28.4	0.81	4.0	21.0 to 36.0
6	26	26.6	0.76	3.8	18.0 to 33.0	21	27.5	0.99	4.4	17.0 to 36.0
7	25	26.9	0.69	3.4	20.5 to 33.0	25	28.3	0.82	4.0	30.0 to 43.0
8	25	28.0	0.87	4.3	18.5 to 37.0	25	30.2	0.68	3.3	25.0 to 40.0
<i>Angle at Junction of Mandibular and Sella Nasion Planes (SN to M)</i>										
4	25	34.9	0.82	4.0	28.0 to 43.0	25	36.2	0.92	4.5	30.0 to 44.5
5	25	33.6	0.75	3.7	26.0 to 43.0	25	35.4	0.79	3.9	27.0 to 42.0
6	26	33.4	0.79	4.0	28.0 to 43.0	21	36.4	0.92	4.1	30.0 to 46.0
7	25	33.2	0.80	3.9	26.0 to 43.0	25	36.6	0.79	3.9	30.0 to 43.0
8	25	33.1	0.93	4.5	25.0 to 43.0	25	36.3	0.68	3.3	31.0 to 42.0
<i>Angle at Junction of Frankfort and Occlusal Planes (F to Oc)</i>										
4	25	14.0	0.86	4.2	6.0 to 27.0	25	13.8	0.79	3.9	8.0 to 23.0
5	25	12.4	0.86	4.2	5.0 to 22.0	25	13.6	0.74	3.6	4.0 to 19.0
6	26	11.0	0.65	3.3	3.0 to 16.0	21	13.9	0.73	3.3	10.0 to 24.0
7	25	13.2	0.53	2.6	8.0 to 18.0	25	13.0	0.56	2.7	8.5 to 21.0
8	25	14.9	0.71	3.5	7.0 to 21.5	25	15.0	0.84	4.1	10.5 to 28.5
<i>Angle at Junction of Sella Nasion and Occlusal Planes (SN to Oc)</i>										
4	25	21.3	0.85	4.2	15.0 to 29.0	25	23.5	0.69	3.4	17.0 to 30.0
5	25	19.1	0.59	2.9	13.0 to 24.0	25	21.1	0.59	2.9	15.0 to 26.0
6	26	17.9	0.67	3.4	12.0 to 25.0	21	22.1	0.51	2.3	17.0 to 26.0
7	25	19.3	0.26	1.3	13.0 to 24.5	25	21.7	0.69	3.4	17.0 to 27.5
8	25	19.9	0.69	3.4	13.5 to 26.0	25	20.9	0.55	2.7	15.0 to 25.5
<i>Inside Obtuse Angle at A or Junction of Lines NA and PA (NAP)</i>										
4	25	9.6	0.82	4.0	2.0 to 17.0	25	12.2	0.81	4.0	2.5 to 21.0
5	25	9.3	0.85	4.2	2.0 to 18.0	25	10.2	0.92	4.5	3.0 to 21.0
6	26	8.6	0.87	4.4	1.5 to 16.0	21	10.5	1.04	4.6	4.0 to 22.0
7	25	8.0	0.88	4.3	0.0 to 14.5	25	8.5	0.85	4.2	0.5 to 17.0
8	25	6.9	0.91	4.4	0.0 to 15.0	25	8.4	0.60	2.9	4.0 to 19.0
<i>Angle at Junction of Facial and AB Planes (NM to AB)</i>										
4	25	5.0	0.53	2.6	0.5 to 11.0	25	5.9	0.48	2.4	1.0 to 10.0
5	25	5.4	0.48	2.3	0.0 to 10.0	25	6.7	0.41	2.0	3.0 to 10.0
6	26	5.6	0.46	2.3	0.0 to 9.0	21	6.6	0.48	2.1	3.0 to 15.0
7	25	4.5	0.46	2.3	0.5 to 8.5	25	5.6	0.52	2.1	1.0 to 9.5
8	25	5.2	0.32	1.6	2.0 to 9.0	25	5.1	0.38	1.9	1.5 to 8.0
<i>Vertical Axis of Lower Incisor to Mandibular Plane (LL to M)</i>										
4	25	85.4	1.40	6.9	71.0 to 101.0	25	83.1	1.14	5.6	72.0 to 91.5
5	25	88.6	1.38	6.8	80.0 to 98.0	25	86.2	1.19	5.8	79.0 to 105.0
6	26	86.1	1.58	7.9	70.0 to 99.0	21	85.6	1.41	6.3	74.0 to 96.0
7	25	91.4	1.49	7.3	76.0 to 104.5	25	89.6	0.84	4.1	75.0 to 100.5
8	25	98.2	1.69	8.3	83.0 to 110.0	25	92.1	1.01	5.0	84.5 to 104.5
<i>Angle at Junction of Upper and Lower Vertical Axes (LL to UU)</i>										
4	25	145.6	2.31	11.3	125.0 to 163.0	25	149.3	1.93	9.5	130.0 to 173.0
5	25	145.2	1.96	9.6	126.0 to 164.0	25	149.2	1.80	8.8	131.0 to 170.0
6	26	141.7	2.88	14.4	118.0 to 174.0	21	149.0	2.11	9.4	130.0 to 163.0
7	25	135.1	2.12	10.4	109.0 to 156.5	25	138.1	1.97	9.6	121.0 to 161.0
8	25	127.0	1.69	8.3	108.0 to 152.0	25	128.5	1.57	7.7	115.0 to 143.0
<i>Posterior Inferior Angle at Junction of Line UU and Frankfort Plane (UU to F)</i>										
4	25	100.1	1.56	7.7	85.0 to 114.0	25	99.0	1.27	6.2	89.0 to 115.0
5	25	99.2	1.37	6.7	85.0 to 117.0	25	97.0	1.23	6.0	86.0 to 112.0
6	26	105.7	1.73	8.7	93.0 to 128.0	21	95.2	2.88	12.9	86.0 to 109.0
7	25	106.3	1.06	5.2	94.0 to 165.0	25	104.3	1.40	6.9	88.0 to 114.0
8	25	109.9	0.83	4.1	96.5 to 121.0	25	109.4	0.95	4.7	100.0 to 120.0
<i>Posterior Inferior Angle at Junction of Line UU and Sella Nasion Plane (UU to SN)</i>										
4	25	94.9	1.43	7.0	83.5 to 110.0	25	92.7	1.30	6.4	79.0 to 111.0
5	25	91.7	1.32	6.5	82.0 to 108.0	25	89.6	1.19	5.8	78.0 to 99.0
6	26	98.5	1.72	8.6	83.0 to 118.0	21	89.1	1.61	7.2	77.0 to 108.0
7	25	100.0	0.94	4.6	87.5 to 107.5	25	96.4	1.57	7.7	76.0 to 105.5
8	25	105.2	1.26	6.2	91.5 to 115.0	25	103.6	1.22	6.0	94.0 to 116.5

\*S.E.M. Standard error of the mean.

†S.D. Standard deviation of the sample.

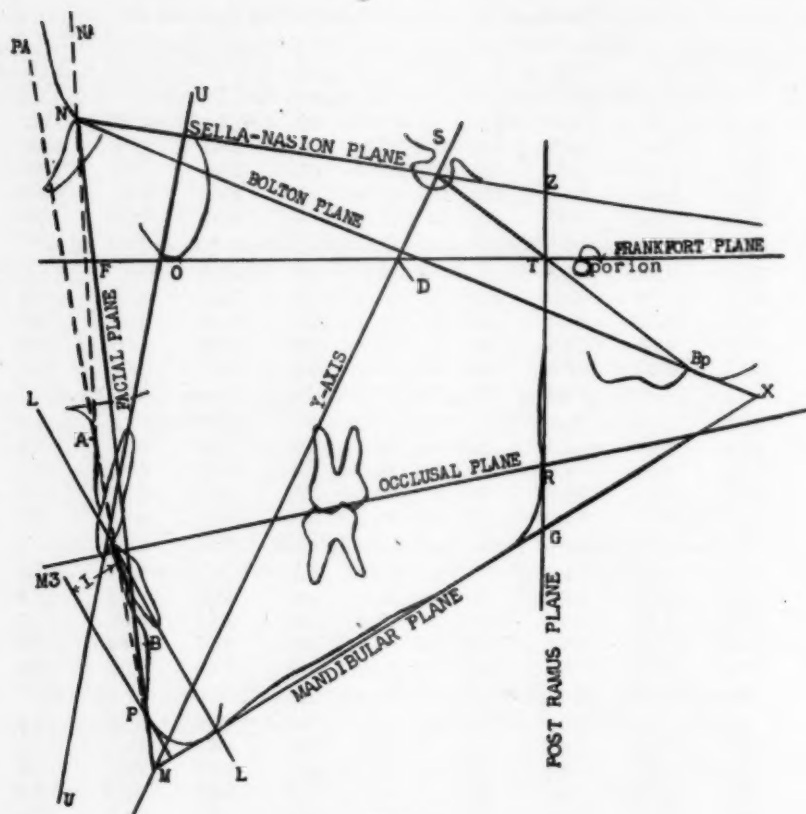


Fig. 1.

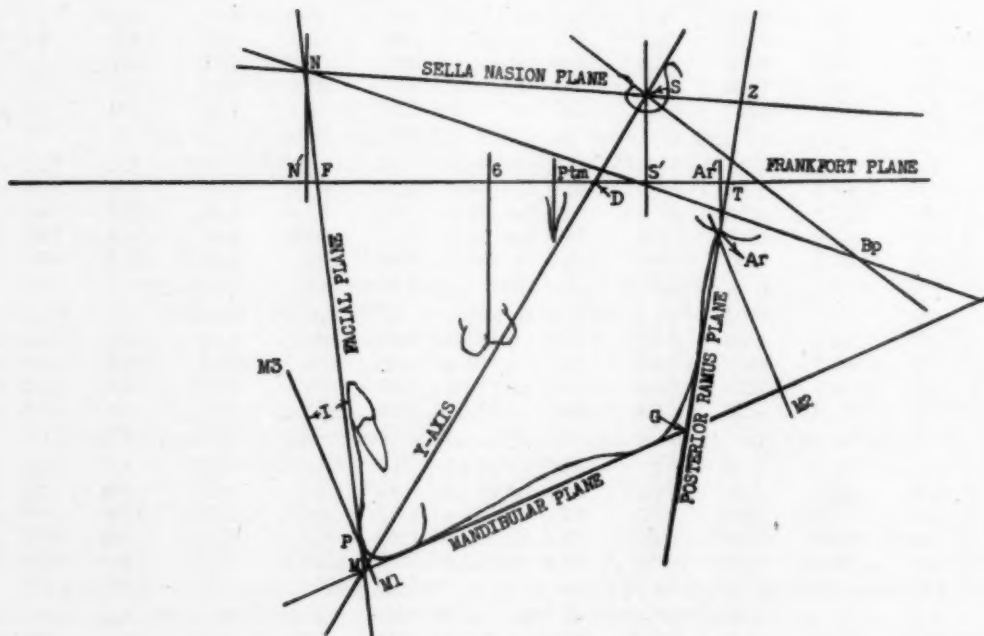


Fig. 2.

Figs. 1 and 2.—Schematic drawings illustrating some of the points, planes, lines, and angles included in this study.

The points and planes, lines and angles selected for obtaining the measurements are in several instances those used by other investigators. Figs. 1 and 2 illustrate the points, planes, lines, and angles, and the following glossary defines them:

## GLOSSARY

*A*—Deepest midline point between anterior nasal spine and prosthion on the premaxilla.

*Ar*—Junction of the posterior ramus plane and the superstructure of the skull (temporal bone).

*Ar'*—Junction of the Frankfort plane and a line perpendicular to it from the point *Ar*.

*B*—Deepest midline point on the mandible between pogonion and infradentale.

*Bp*—Bolton point. The highest point on the concavity behind the occipital condyles.

*D*—Junction of the Y axis and Frankfort plane.

*F*—Junction of the Frankfort and facial planes.

*G*—Junction of the posterior ramus and mandibular planes.

*I*—The shortest distance between the labial surface of the mandibular incisor and the line *M<sub>1</sub>M<sub>2</sub>*.

*LL*—A line drawn through the long axis of the lower central incisor and extended to intersect the mandibular plane.

*M*—Junction of the facial and mandibular planes.

*M<sub>1</sub>M<sub>2</sub>*—The distance between the points *Ar* and *P* as projected perpendicular to the mandibular plane.

*M<sub>1</sub>M<sub>2</sub>*—A line perpendicular to the mandibular plane and tangent to the mandible at the pogonion.

*N*—Nasion. Junction between the sutures of the frontal and the nasal bones.

*N'*—Junction of the Frankfort plane and a line perpendicular to it from the nasion.

*O*—Orbitale. The lowest point on the infraorbital margin of the left orbit.

*P*—Porion. The highest point on the roof of the left external auditory meatus.

*Ptm*—Junction of the Frankfort plane and a line perpendicular to it from the pterygomaxillary fissure.

*R*—Junction of the occlusal and posterior ramus planes.

*S*—Center of sella turcica. The midpoint of sella turcica arbitrarily determined.

*S'*—Junction of the Frankfort plane and a line perpendicular to it from the center of the sella turcica (*S*).

*T*—Junction of the Frankfort and posterior ramus planes.

*X*—Junction of the Bolton and mandibular planes.

*Z*—Junction of the sella nasion and posterior ramus planes.

*6*—Junction of the Frankfort plane and a line perpendicular to it from the buccal groove of the maxillary left first permanent molar.

*SM*—Y axis. A line extending from the center of sella turcica to point *M* or mental angle.

*F to M*—The inside angle formed by the junction of the Frankfort and mandibular planes.

*F to Oc*—The inside angle formed by the junction of the Frankfort and occlusal planes.

*LL to M*—The inside angle formed by the junction of the line *LL* and the mandibular plane.



patient's dental, facial, and cranial structures. By so doing it can be determined whether the patient's structures are below, equal to, or above the average size, or whether the angular relationships of the structures are more acute, equal to, or more obtuse than the average.

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## A CEPHALOMETRIC APPRAISAL OF THE RESULTS OF CERVICAL GEAR THERAPY\*

T. M. GRABER, D.D.S., M.S.D., PH.D.,\*\* CHICAGO, ILL.

THERE has been considerable emphasis recently on extraoral anchorage in Class II therapy. The present study has been undertaken to determine the indications, contraindications, and changes induced by one form of extraoral anchorage—the cervical gear.

Behind the studies a survey of 150 Class II, Division 1 (Angle) cases. In 107 of these, the lower denture was considered to be in relatively good balance with basal bone; rotations were minor in degree or nonexistent. The major distinguishing criterion between these Class II cases and a like group of excellent occlusion cases was the anteroposterior basal bone dysplasia. Treatment has been started in 100 of the malocclusion cases to eliminate the Class II relationship and to reduce the basal dysplasia, if possible. The appliances consist of a heavy gauge maxillary arch wire, bands on the first permanent molars, a metal spring-type cervical gear, and acrylic bite plates. No appliance has been placed on the lower dental arch. Models, cephalometric radiographs, and dental radiographs have been taken before and after treatment, with progress records at six-month intervals. The following results have been noted on the sixty-five cases that have now completed the initial therapy.

1. It is possible to change maxillo-mandibular apical base relationships by cervical gear therapy. This is the rule, rather than the exception.

2. In fifty-four of the sixty-five cases, the Class II tooth interdigitation was eliminated.

3. Tendency for molars to tip under cervical traction was lessened by permitting the arch wire to maintain positive pressure on the maxillary incisor segment.

4. In severe basal dysplasias, it was necessary to incline the maxillary incisors excessively to the lingual in order to reduce the incisal overjet.

5. Where the overbite was deep, a bite plate appliance was placed to reduce the overbite and to obtain clearance to retract the maxillary incisors.

6. There was no significant change in mandibular incisor inclination except in those cases where the bite plate was used.

7. In six cases of severe basal malrelations, maxillary second permanent molar teeth were removed prior to treatment. In all cases, a complete reduction of the Class II tooth relation was obtained by moving the maxillary denture posteriorly.

\*Preliminary findings of a continuing study.

\*\*Department of Orthodontics, Northwestern University Dental School.

## Editorial

### Dental Students, 1952-1953

A REPORT on the number and distribution of students attending colleges in the United States, published by the Council on Dental Education of the American Dental Association, contains information which should be of interest to all dentists.

During the ten-year period from 1942 to 1953, inclusive, the number of dental undergraduates registered annually varied from a low of 7,274 in 1945 to a high of 12,370 in 1953. Of the latter number, approximately 300 students were from foreign countries and United States possessions. From 1943 to 1948 there was an average decrease of 725 students annually, while the average increase since then is around 2,550 annually compared to 1942. However, the average increase over the ten-year period just mentioned is 1,000 undergraduates annually, while the estimated need for dentists to meet increases in population, increased military demands, and depletion due to death and retirement is about 3,000 dentists annually.

In 1952 the dentist-population ratio in fifteen states ranged from 3,000 to over 5,000 persons per dentist. The state of New York, with one dentist to every 1,135 persons, led the rest of the states in dentist-population ratio.

The number of women dentists in most continental European countries is high and is actually above that of men in some Scandinavian countries. There is only one woman dental student for every 120 men studying in the United States.

Pennsylvania, with 1,442, had the highest number of dental students enrolled in its dental schools; Illinois, with 1,053, was second; and the state of New York, with 997 enrolled dental students, was third.

New York University College of Dentistry, with an enrollment of 609, had the highest number of students; the University of Pennsylvania was second; Temple University was third; Marquette, in Wisconsin, was fourth; and the University of Maryland was fifth. Columbia University, with a total of 150 students, was Number 37 of the forty-two dental schools, and Harvard University, with a total of 53 students, was last.

The twenty dental schools offering courses for dental hygienists had a combined total of 946 students. This does not include, of course, the dental hygienists being trained by Government and private agencies.

While the American Dental Association is against Government operation of dental schools, it is apparently indifferent as to who educates dental hygienists and dental laboratory technicians.

Fully 40 per cent of the undergraduate students were holders of bachelor's or other college degrees and an additional 27 per cent had three years of college training.

Pennsylvania, with the same number of dental schools as the state of New York, had a dental student enrollment of 1,442, of whom only 514 resided within its borders. Illinois, with three schools, had an enrollment of 1,053 students, while the total number of dental students residing in the state numbered only 670.

A total of 1,350 undergraduate dental students gave New York as their state of residence. Of this number, only 879, or 65 per cent, attended dental college in the state, while seven out of twenty were receiving their education elsewhere, usually at a high premium in the form of increased tuition fees charged by dental schools to out-of-state students.

Seventeen of the forty-two dental schools charge higher tuitions for out-of-state students. These differentials range from \$2,400 at the University of North Carolina to \$300 at the University of Texas. Most of the schools charge between \$800 and \$1,200 more to out-of-state residents than to students in their own state.

*J. A. S.*

## In Memoriam

**CLARE KENNETH MADDEN**

**1899-1953**

THE dental and orthodontic professions were greatly shocked on Sept. 17, 1953, to learn of the sudden and untimely death of their great friend and colleague, Dr. Clare Kenneth Madden of Greenwich, Conn.

Dr. Madden was born on Nov. 13, 1899 in St. Louis, Mich., the son of Ernest Albert and Maude Beadle Madden.

He received his dental degree at the University of Michigan in 1923 and finished his orthodontic training in 1936 at Columbia University, where he later became an assistant clinical professor of orthodontics.

From 1936 to 1953 Dr. Madden practiced the specialty of orthodontics in Greenwich, Conn., where he became greatly beloved, not only by his dental associates, his orthodontic confreres, and his many patients, but also by the townspeople, because of his active participation in civic, musical, and religious affairs.

Because of his unselfish spirit of giving of professional knowledge throughout this and other countries, he became internationally known as an authority on orthodontics and this resulted in his unanimous election to the vice presidency of the American Association of Orthodontics in 1952.

Dr. Madden gave unstintingly of his knowledge and enthusiastically entered into educational work. He lectured on orthodontics in many countries, including the United States, Canada, Cuba, and Holland.

His writings were well known in the orthodontic field, where he became a most dependable advocate and teacher of the Johnson philosophy of orthodontic procedures. For many years he has taken a very vital part in all of the twenty-one courses given on the methods of treatment advanced by his very close friend and great admirer, Dr. Joseph E. Johnson.

He has been an active director of the Johnson Alumni Association and an ardent worker in the arranging of programs for the American Association of Orthodontists.

Besides his associate professorship at Columbia University he was also a visiting professor at Washington University in St. Louis and at the University of Havana.

He was a member of the Psi Omega Fraternity and in June, 1950, was elected to membership in Omicron Kappa Upsilon, an honorary dental fraternity.

In 1918 he did his duty by serving in the United States Army.

Dr. Madden's professional organizations included the county, state, and national dental societies; the Northeastern, American, Cuban, and Dutch Associations of Orthodontics; the New York Academy of Dentistry; the American College of Dentists, and he was a diplomate of the American Board of Orthodontists.

In the passing of Dr. Madden we have lost a fellow whose outstanding character reflected the highest honor in the dental profession; a man who was gentle, kind and modest; a man of courage and conviction from whose untiring efforts and unselfish labors the public and the profession have been greatly benefited; a man of talent and ability whom we could depend upon and trust implicitly. Being honored in his profession, happy in his surroundings, beloved by his friends, and respected by all with whom he came in contact, we have lost a friend whose memory will continue indefinitely to provide an example for us to follow.

Clare Madden's life was a typical example to others of which the following quotation from Dr. Daniel A. Poling may be most justly applicable:

What a man does lives after him  
What a man thinks conquers time.  
He reappears in his children  
He loves beyond the grave  
And his soul was not born to die.

WHEREAS; we of the dental profession have learned with profound sorrow of the passing of our beloved confrere, Dr. Clare Kenneth Madden, whose labors have ever been in the interest of his profession and always at the exclusion of any personal ambition and whose kindness and unselfish devotion to his family and his friends will ever be remembered, be it therefore

*Resolved* that this deep sense of bereavement be spread upon our minutes as an everlasting memorial to him who became so dearly beloved in his profession; and be it further

*Resolved*, that a copy of these resolutions be sent to the members of his family as an expression of our deep sympathy and heartfelt condolence.

Adopted by the Northeastern Society of Orthodontists.

Nov. 9, 1953.

LOWRIE J. PORTER, CHAIRMAN,  
NECROLOGY COMMITTEE.

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### MAURICE C. BERMAN

1909-1953

**M**AURICE C. BERMAN was born Dec. 29, 1909, and died Aug. 22, 1953, at the age of 44 years.

He graduated from the Chicago College of Dental Surgery, Loyola University, in the class of 1932, and practiced orthodontics in Chicago until his death.

He attended classes in orthodontics at Northwestern University Dental School; also at Columbia University and the University of Michigan. He attended several courses given by Dr. Robert H. W. Strang, and was a member of the Tweed Study Club of Illinois.

Dr. Berman was a member of The Chicago Dental Society, the American Association of Orthodontists, and the Chicago Association of Orthodontists.

He was a diplomate of the American Board of Orthodontics and the material that he submitted to the Board as a partial requirement for a diploma will be included in the exhibit to be displayed by the Board at the coming meeting of the American Association of Orthodontists.

He contributed generously in the activities of dental organizations. He was correspondent for the West Side Branch of the Chicago Dental Society and served for five years as a member of the Essay Division of the parent society.

Dr. Berman also was a member of the Institute of Modern Medicine, University of Illinois Plastic Research, and Internationale of Dentistry in Canada.

He was a willing worker; modest and conscientious in his efforts to improve himself as an orthodontist and give his patients the best care.

Dr. Berman leaves his wife, Bernice, a daughter, Diana, and a brother, Arthur C. Berman, M.D. To these we extend the sincere sympathy of all of the members of the Central Section of the American Association of Orthodontists, and BE IT RESOLVED that these resolutions be made a part of our records, and that an appropriate message of sympathy be sent to Mrs. Berman and her family.

COMMITTEE:

JOE M. PIKE

A. B. THOMPSON

CHARLES R. BAKER, CHAIRMAN.

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**JAMES A. BURRILL**

**1877-1953**

**I**T BECOMES our duty to record the passing of one of our most respected and beloved members.

James A. Burrill was born May 25, 1877, in Oxford County, Ontario, Canada. He was the eighth child of Charles and Rebecca (Birkett) Burrill. He attended the Norwich County elementary schools and Brantford Collegiate Institute. He graduated from University of Michigan School of Dentistry in 1905, attended the Angle School of Orthodontia in 1905, and began the practice of orthodontics in Chicago in 1906. He was the fourth orthodontist to practice in Chicago.

He served on the faculty of University of Illinois School of Dentistry from 1907 to 1913, and was affiliated with the following organizations:

Charter member of Chicago Dental Research Club, which for more than a quarter of a century held weekly meetings devoted to dental and related subjects.

Charter member of the Chicago Association of Orthodontists, and President in 1927.

An active worker in the activities of the American Association of Orthodontists, and President in 1934.

Diplomate of the American Board of Orthodontics and also a director of that organization.

Member of the Edward H. Angle Society of Orthodontia.

Member of Omicron Kappa Upsilon (dental honor fraternity), Delta Sigma Delta Fraternity, Illinois Athletic Club of Chicago, and the Skokie Country Club. He was an enthusiastic golfer and fisherman.

About ten years ago Dr. Burrill suffered a serious heart attack and was confined to his bed for many weeks. Finally, he recovered and returned to his office and practiced for several years before retiring. He continued as an active member in our organization and participated generously in orthodontic activities. Recently, he had another heart attack and spent six weeks in the Evanston hospital until he passed away Oct. 11, 1953, at the age of 76 years.

Dr. Burrill, "Jim" to his friends, was one of our most highly respected orthodontists. In his practice he was a true perfectionist and an outstanding operator. He left no stone unturned in his efforts to accomplish for his patients the ultimate in his treatment. Never a faddist, he kept pace, however, with all of the advances in orthodontics, and his critical judgment was always a studied one.

To those of us who were privileged to know him personally, Jim Burrill revealed a kindness of character which was outstanding. He was a modest gentleman always, a man whose judgment one instinctively respected. His way and philosophy of life were matters of concern to him, and his friendships were sincere and sound. We shall keenly miss his stabilizing influence in our councils. By his passing, orthodontics has lost one of its finest and best qualified pioneers in practice.

Dr. Burrill was married to Miss Bertha Youngs in April, 1906. He leaves his widow, a daughter, Mrs. Jane Alfreds McCafferty, three sons, Drs. Dan Y. and James H. (dentists), and Richard William. To these we extend the sincere sympathy of all of the members of the Central Section of the American Association of Orthodontists, and be it

RESOLVED, that these resolutions be made a part of our records and that a copy of same be sent to Mrs. Burrill and her family.

NECROLOGY COMMITTEE:

Joe M. Pike

A. B. Thompson

Charles R. Baker, Chairman

**JOSEPH P. SERAFINO**

1897-1953

**J**OSEPH P. SERAFINO died, following a heart attack, at his home in Beaumont, Texas, Friday, Oct. 30, 1953.

Dr. Serafino was born and reared in Beaumont, and was graduated from the Texas Dental College in 1921. He was a member of the Psi Omega Fraternity.

In 1926 he married Marguerite Fértita, and they were the very proud parents of one daughter, Frances Jean.

Dr. Serafino practiced general dentistry in Houston until 1938, when he became interested in orthodontics, and shortly after limited his practice. He was one of the first members of the Tweed Study Group of the Southwest, and was an inspiration to many young men.

In 1946 he moved to Beaumont to continue the practice of orthodontics.

Dr. Serafino was an accomplished musician, and had an orchestra of his own during his dental education.

He was a member of the Sabine District Dental Society, Texas State Dental Society, American Dental Association, Southwestern Society of Orthodontists, American Association of Orthodontists, and Tweed Study Group of the Southwest.

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**HENRY SPENADEL**

**O**N JUNE 9, 1953 the Northeastern Society and the dental profession lost one of their outstanding benevolent confreres, Dr. Henry Spenadel.

Dr. Spenadel's professional life was a clear exemplification of the principle of giving—not only of himself through his efforts and unselfish devotion to dentistry, but also by his financial gifts in the establishment of the "Henry Spenadel Award Fund" of the Eastern Dental Society, the First District Dental Society "Henry Spenadel Fund for the Advancement of Dental Education," and by his gift to the William J. Gies Foundation for the Advancement of Dentistry and many other professional institutions and charities. He gave large sums for research on oral cancer and for the establishment of a dental school in Israel. His total gifts to dentistry will amount to over half a million dollars.

Dr. Spenadel graduated from the New York College of Dentistry in 1904 and joined the Eastern Dental Society where he pioneered in the teaching of dental casting procedures, and in 1928 was elected to its presidency. He later became a member of the Board of Directors of the First District Dental Society.

In 1925 he entered the specialty of orthodontics and became a member of the Northeastern Society of Orthodontists and the American Association of Orthodontists. He was a member of the New York Academy of Dentistry, the American College of Dentists, and a member of the Sigma Epsilon Delta Fraternity.

His gentle nature, kind thoughts, and cheerful disposition, as well as his untiring efforts, for the advancement of dentistry will be remembered not only by those who were privileged to know him, but by the entire profession of dentistry to which he unselfishly devoted his life.

*Whereas* the passing of Dr. Henry Spenadel will be a great loss to the profession and to this organization, and, since his unselfish devotion and generous spirit have so greatly reflected honor upon his dental profession, let this report serve as a lasting memorial to him, the same as his steadfastness, dependability, and beneficent influence have been stepping stones of advancement to his profession, be it therefore

**RESOLVED** that a copy of these resolutions be spread upon our minutes, and a copy transmitted to his family as an expression of our sincere sympathy and heartfelt condolence.

Adopted by the Northeastern Society of Orthodontists, Nov. 9, 1953.

LOWRIE J. PORTER, CHAIRMAN,  
NECROLOGY COMMITTEE.

## Department of Orthodontic Abstracts and Reviews

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Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmnn, 654 Madison Avenue, New York City

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**An Apparatus and Technique for Temporomandibular Radiography:** By Robert W. Donovan, D.D.S., M.S.D., Department of Orthodontics, Northwestern University Dental School, Chicago, Ill.

Anyone attempting for the first time to obtain a radiograph of the temporomandibular joint area is confronted by innumerable techniques and methods advocated in the past and present literature. The simple fact that so many methods have been tried and reported points out that the problem under consideration is a difficult one and can be approached from many angles, each with a fair amount of success, but none with complete satisfaction.

Essential differences in the various techniques seem to lie in one or more of the following factors:

1. Types of x-ray equipment used.
2. Area and direction the central ray enters the subject.
3. Distance of film-target distance.
4. Positioning devices for subject and x-ray equipment.

The apparatus under present consideration consists of a cassette holder and a head positioner. The head is held by means of ear rods in an upright comfortable position oriented in the Frankfort Plane. The x-ray beam enters the head on the side opposite the condyle being studied at an angle of 19 degrees above and 15 degrees behind. The film is positioned perpendicular to the central ray and receives an image of almost the entire head.

With the standard D 2 x-ray head set at maximum KVP and 20 milliamperes, the exposure averages one-half second.

As the cassette holder and x-ray head are in constant position, when exposure of the opposite condyle is desired the head positioner is adjusted to another predetermined position and the patient is turned in the opposite direction.

The technique seems to offer the following advantages:

1. The patient is seated in a comfortable upright position.
2. The head is held firmly to allow repeated exposures and serial studies.
3. The area exposed allows use of many anatomic landmarks.
4. Constant cassette and x-ray head position and predetermined head positioner angles save time.
5. Short exposures minimize patient movement distortion.

**The Influence of Increments, Time, and Direction of Facial Growth on Orthodontic Therapy:** By Robert W. Donovan, D.D.S., M.S.D., Department of Orthodontics, Northwestern University Dental School, Chicago, Ill.

The material used in this study consisted of cephalometric radiographs taken with the mandible at rest position and with the teeth in occlusion on eighty-seven individuals possessing malocclusion of the teeth. The radiographs

were made before, during, and subsequent to orthodontic correction of the malocclusions. The number of cephalometric examinations made on each patient varied from a minimum of three to a maximum of eight. All told, 480 radiographs in occlusal position and a like number in physiologic rest position were traced and compared.

Concrete conclusions and accurate statistical evaluation must await completion of the entire study now under way, but some trends and characteristics seem to be fairly obvious at this date. Many factors contribute to the facial growth during this period. Variation in growth sites, amount, and direction is considerable. Considered here are only a few important factors—the change in the value of angle SNa and SNb, the direction of growth from point S of the maxillary apical base (point a), and the direction of growth from point S of the mandibular apical base (point b).

During a specified period of time of treatment, the combination of growth that can occur may vary considerably. Over a period of years, though, the general trend of the individual usually is quite constant. The actual change in SNa SNb difference during the two to three years of orthodontic treatment is seldom great; although a degree or two change at an older age, when the face is longer, is much more significant in actual horizontal millimeter relation than the same degree or two at an early age, or in the short face.

If there is considerable horizontal maxillary growth, it seems possible, especially with the use of cervical or occipital forces, to orthodontically:

1. Inhibit somewhat the forward path of the maxillary dental arch in correction of Class II arch relation.
2. Inhibit somewhat the forward path of the maxillary molars so as to attain an adequate arch length.
3. Achieve a combination of 1 and 2.

If there is a maxillary growth pattern in an equalized horizontal and vertical path, the same three combinations are possible, but not as readily successful.

If the maxillary growth pattern is mainly in a vertical position, the three possibilities are not often successful and extensive tipping and extraction must be resorted to more frequently.

Vertical mandibular growth plays an important part in the correction of excessive overbite. As is well known, depressive forces are the most difficult to achieve. If there is not the vertical growth potential present to allow inhibiting forces and extrusion forces, the correction must be all of a depressive nature, and consequently slowly and difficultly attained, if at all.

#### CONCLUSIONS

1. The quality of orthodontic results, time required for treatment, and reaction to mechanical therapy are influenced by the following:

- (a) The anteroposterior relation of the mandible to maxilla.
- (b) The increments of facial growth during orthodontic treatment.
- (c) The direction of growth of facial structures (maxilla and mandible).

2. It is possible by means of cephalometric radiography to appraise accurately the anteroposterior relation of the mandible to maxilla.

3. The growth trends of facial structures can be only generally appraised by cephalometric radiography before orthodontic treatment.

4. At the present time, increments, detailed direction, and the time of growth cannot be anticipated in individual cases before orthodontic treatment.

## News and Notes

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### American Association of Orthodontists

#### Fiftieth Annual Session

Preliminary reports of the program for the 1954 session of the American Association of Orthodontists have been issued by the president, James W. Ford, and the chairman of the program committee, Ralph G. Bengston. The meeting will be held May 16 through May 20, 1954 at the Palmer House in Chicago.

Essayists who to date have accepted invitations include the following:

ALTON W. MOORE, SEATTLE, WASH. Facial Growth and Its Relation to Orthodontic Treatment.

JOSEPH E. JOHNSON, LOUISVILLE, KY. A Simple Technique Proving the Ability of the Twin Wire Mechanism to Move Maxillary Molars Either Mesially or Distally.

JACOB D. FRANKLIN, MILWAUKEE, WIS. The Effect of High Kilovoltage on Hard and Soft Tissue Definition in Lateral Cephalometric Roentgenograms.

VERNON L. HUNT, EUREKA, CALIF. Practice Management; Efficiency in Office Design; Own Your Own Office as an Investment; Early Preventive Treatment; Investments for an Orthodontist.

ALBERT C. HEIMLICH, SANTA BARBARA, CALIF. Selective Grinding, an Integral Part of Orthodontic Therapy.

WALDO O. URBAN, EVANSTON, ILL. A Radiographic Cephalometric Study of Changes Associated With Orthodontic Treatment of Selected Cases of Malocclusion Using Upper Appliance With Occipital Anchorage.

Other essays will be presented by William J. Adams, Indianapolis, Ind., and Richard Manley, Boston, Mass., but their titles are not yet available.

There also will be a panel discussion on "Treatment in the Mixed Dentition." The chairman will be Leuman M. Waugh, New York, N. Y. Members of the panel include George W. Hahn, Berkeley, Calif., S. J. Kloehn, Appleton, Wis., and H. K. Terry, Miami, Fla.

A symposium on "The Temporomandibular Articulation" also is listed. The chairman is John R. Thompson, Chicago, Ill. Members on this panel will be Harry Sicher, Chicago, Ill., William S. Brandhorst, St. Louis, Mo., Robert M. Ricketts, Pacific Palisades, Calif., and Robert W. Donovan, Chicago, Ill.

The annual prize essay and an afternoon devoted to table clinics also are scheduled on the scientific program.

Plans for the social events are well advanced. Exclusive parties for the ladies will be provided, in addition to the annual reception and dinner dance in honor of President and Mrs. James W. Ford. There will also be the customary buffet supper, stag banquet, and the Golden Anniversary and International luncheons.

Early reservations made directly with the Palmer House are advised.

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### American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Palmer House in Chicago, Ill., May 11 through May 15, 1954. Orthodontists who desire

to be certified by the Board may obtain application blanks from the secretary, Dr. C. Edward Martinek, 661 Fisher Bldg., Detroit 2, Mich.

Applications for acceptance at the Chicago meeting, leading to stipulation of examination requirement for the following year, must be filed before March 1, 1954. To be eligible an applicant must have been an active member of the American Association of Orthodontists for at least three years.

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### Great Lakes Society of Orthodontists

The 1954 meeting of the Great Lakes Society of Orthodontists is to be held Oct. 31 through Nov. 3, 1954 at the Statler Hotel in Detroit, Mich.

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### Middle Atlantic Society of Orthodontists

The annual meeting of the Middle Atlantic Society of Orthodontists was held at the Hotel Claridge, Atlantic City, N. J., on Oct. 18, 19, and 20, 1953.

An informal party, including cocktails and buffet supper, honored President and Mrs. Charlie Patton on Sunday evening.

Scientific sessions throughout the meeting were based on the theme "Class II, Division 1."

The program on Monday included Robert E. Moyers of Ann Arbor, Mich., who talked informally and in his usual engaging manner on "Differential Diagnosis of Temporomandibular Problems." Discussion, which again formed an important feature of the program, was freely entered into by Reed, Stucklen, Anderson, Herbstman, Sager, Hawley, Eby, and Schlechter.

Luncheon was highlighted by the presentation to Oren Oliver of Nashville, Tenn., of the Certificate of Honorary Membership in the Society by Past President Anderson.

In the afternoon a paper entitled "The Treatment of Class II Malocclusion With the Edgewise Arch Appliance, Utilizing Force From Light Resilient Arch Wires" was presented by Will M. Thompson, Jr., of Pittsburgh, Pa. There was a discussion by Gilbert, Hawley, Dimond, Krishtool, White, and Hillyer. This paper was followed by four round-table discussions headed by Hopkins, Swinehart, Sager, and Webster.

On Tuesday the Society enjoyed hearing Joseph D. Eby of New York on "A Rational Viewpoint in Orthodontics With Special Reference to Class II Malocclusions and Other Problems." As usual, the presentation by this gentleman was full of "meat" and provided ample material for thought and discussion.

In the afternoon the theme subject "Class II, Division 1" was subjected to a vigorous two-hour discussion, with Moyers, Thompson, and Eby acting as a panel, and Anderson as moderator.

Officers elected for the year 1953-1954 are as follows:

Raymond C. Sheridan, *President*  
B. Edwin Erikson, *President-Elect*  
Daniel E. Shehan, *Vice-President*  
Gerard A. Devlin, *Secretary-Treasurer*  
Stephen C. Hopkins, *Editor*  
Emil O. Rosenast, *Director*  
Aubrey P. Sager, *Alternate*

The weather was perfect and the members and, especially, the wives, enjoyed the boardwalk activities. The next annual meeting will also be in Atlantic City in November, 1954.

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### Northeastern Society of Orthodontists

The Northeastern (formerly New York) Society of Orthodontists held its fall meeting Nov. 9 and 10, 1953, at Hotel Somerset, Boston, Mass. The program follows:

**SQUIBS FROM A YANKEE SCRAPBOOK** (Colored motion picture with commentary by "Blackie"). Alton H. Blackington, well-known New England radio and television commentator.

**A TECHNIQUE OF SURGICAL ORTHODONTICS.** Daniel J. Holland, Brookline, Mass.

**TREATMENT PROBLEMS, THEIR ORIGIN AND ELIMINATION.** Robert H. W. Strang, Bridgeport, Conn.

**RESOLUTION OF THE NORTHEASTERN SOCIETY OF ORTHODONTISTS—JOHN VALENTINE MERSHON, D.D.S., D.Sc.** Presented by Leuman M. Waugh.

**LATE GROWTH CHANGES OF THE HUMAN FACE.** Allan G. Brodie, Chicago, Ill.

**THE NEWBURG-KINGSTON CARIES FLUORINE STUDY. VI. CORRELATION OF INGESTED WATER FLUORIDES TO DENTOFACIAL DEVELOPMENT: A PRELIMINARY REPORT.** David B. Ast, Albany, N. Y.

**THE ROLE OF TEETH IN MAN'S BECOMING HUMAN.** Earnest A. Hooton, Cambridge, Mass.

**WHY LIFE INSURANCE?** Walter S. Palmer, Boston, Mass.

**TIMING IN ORTHODONTIC TREATMENT.** Allan G. Brodie, Chicago, Ill.

**SOME CRITERIA IN THE DIAGNOSIS AND TREATMENT PERTINENT TO THE EXTRACTION OF TEETH IN ORTHODONTICS.** Herbert I. Margolis, Boston, Mass.

**AMERICAN BOARD OF ORTHODONTICS.** Raymond L. Webster, Providence, R. I.

**MASTICATORY FUNCTION OF ORTHODONTIC PATIENTS.** R. S. Manly, Boston, Mass.

#### CLINICS:

1. Clinic by students supplementing paper by Herbert I. Margolis, Boston, Mass.
2. **THE VERTICAL CEPHALO-ROTATOR FOR STANDARDIZED TEMPOROMANDIBULAR ROENTGENOGRAM.** Herbert I. Margolis and Samuel Glossman.
3. **THE POSTERIOR COMPONENT FORCE.** A. I. Fingerroth, New York, N. Y.
4. **FRACTURE REDUCTION USING ORTHODONTIC TECHNIQUE—CHILDREN'S HOSPITAL.** Melvin Cohen, Boston, Mass.
5. **A METHOD FOR STUDYING THE HISTOLOGIC RESPONSE TO TOOTH MOVEMENT IN THE ALBINO RAT.** Charles M. Waldo† and Julian M. Rothblatt, Harvard School of Dental Medicine.
6. **A DEMONSTRATION OF AN INK TRACING TECHNIQUE.** Peter Yen, Harvard School of Dental Medicine.

The following officers were elected:

J. A. Salzmann, *President*

Philip E. Adams, *President-Elect*

Oscar Jacobson, *Secretary-Treasurer.*

The next Annual Meeting of the Northeastern Society of Orthodontists will be held at the Commodore Hotel in New York, N. Y., on March 8 and 9, 1954.

### Rocky Mountain Society of Orthodontists

The annual meeting of the Rocky Mountain Society of Orthodontists was held at Denver in the Study Club Rooms of the Denver Dental Association in the Denver General Hospital, Nov. 2 and 3, 1953.

There were thirty-four orthodontists in attendance, twenty-four from Colorado, three from New Mexico, three from Utah, and one each from California, South Dakota, Wyoming, and Nebraska.

†Deceased.

Dr. Spencer Atkinson of Pasadena was the guest of the Society, and presented three lectures: "Suggestions Concerning (1) Diagnosis, (2) Treatment, and (3) Retention, of Orthodontic Cases in the Light of Evidence Derived From the Examination of 2,000 Skulls."

Because of Dr. Atkinson's acknowledged experience and ability, both as a practitioner of orthodontics and for his scientific research in orthodontic subjects, the lectures were intensely interesting and educational.

Another guest speaker was William E. Hines, M.D., of Denver who gave an excellent address on "Endocrinological Aspects of Orthodontics."

Dr. Ernest T. Klein of Denver presented a most helpful paper and clinic on "Balancing Occlusion in Treated Orthodontic Cases."

Luncheon was served at the Denver Press Club on both days of the meeting and the afternoon of the last day was devoted to a panel discussion by Spencer Atkinson, William Hines, Henry Hoffman, and Leonard Walsh, with Oliver Devitt serving as moderator.

At the business meeting following, five active members were elected, one was received by transfer, and three were elected as associate members.

The following officers were elected for the ensuing year:

Don V. Benkendorf, Denver, *President*

Peter W. Appel, Cheyenne, Wyoming, *Vice-President*

Curtis L. Benight, Denver, *Secretary-Treasurer*

Henry F. Hoffman, Denver, *Editor*

Kenneth R. Johnson, Colorado Springs, *Director*

Ernest T. Klein, *Alternate representative on the Board of Directors of the American Association of Orthodontists*

H. F. H.

### Southern Society of Orthodontists

A meeting of the Southern Society of Orthodontists was held Nov. 1, 2, and 3, 1953, in Orlando, Fla. Many orthodontists and their wives arrived in Orlando on Saturday evening, and they were met by members of the Local Arrangements Committee and President Leland T. Daniel. All of those who arrived on Saturday night were entertained by Dr. Daniel in his suite of rooms in the Orange Court Hotel.

On Sunday evening, Nov. 1, at 7:00 P.M., there was a cocktail party, followed by a buffet supper in the Marine Room.

The meeting opened Monday morning at 9:30 A.M., and the invocation was given by Dr. William H. Kadel, pastor of the First Presbyterian Church, Orlando, Fla. This was followed by the welcoming address by the Hon. J. Rolfe Davis, Mayor of Orlando. The response was by Walter T. McFall of Asheville, N. C. Then Leland T. Daniel gave his address, as president of the Southern Society of Orthodontists. It was an excellent address and was well received by all present. Following Dr. Daniel's address, from 11:00 to 12:00, a paper, "Orthodontics—Force of Persuasion?" was given by S. J. Kloehn. Dr. Kloehn gave a very excellent presentation which was well received. At 12:30 a luncheon was given for the President of the American Association of Orthodontists, J. W. Ford. Dr. Ford gave an excellent address, "Your A.A.O." outlining some of the future problems that are facing orthodontists today. This was a very fine luncheon and was enjoyed by all of those who were present.

At the afternoon session, from 2:00 to 3:15, "The Dental and Orthodontic Implications in the Handling of the Cleft Palate Individual" was presented by Herbert K. Cooper. Dr. Cooper gave an excellent talk and everyone present enjoyed it very much. He outlined the importance of the orthodontist in cleft palate care. His pictures and his talk were well received. From 3:15 to 4:40 there was a forum discussion by Frank P. Bowyer, moderator, and a panel consisting of Herbert Cooper, S. J. Kloehn, and James W. Ford.

This panel discussion was well received and everyone seemed to get a great deal out of it. At 6:30 P.M. there was a reception and cocktail party, honoring President and Mrs. Leland T. Daniel. The cocktail party was followed by a dinner which was held outside on the Tropical Lawn. The southern hospitality was out of this world.

On Tuesday morning, Nov. 3 there was a business session, which included Reports of Secretary-Treasurer, Executive Board, President's Address, and Committee Reports. These were followed by unfinished business and new business, and then the election of officers as follows: Leigh C. Fairbank, President-Elect, became President of the Southern Society of Orthodontists, and announced that the next meeting would be held in Washington, D. C., at the Mayflower Hotel, Oct. 31 through Nov. 3, 1954. Olin W. Owen of Charlotte, North Carolina was chosen president-elect; H. C. Shotwell of Lynchburg, Va., vice-president; M. D. Edwards, Montgomery, Ala., secretary-treasurer; and H. K. Terry, Miami, Fla., assistant secretary. The new member of the Board of Directors is John Atkinson of Louisville, Ky.

After the meeting adjourned at 10:30, the entire group visited the Cypress Gardens.

Wednesday morning, Nov. 4, featured twenty Clinics in the Main Ball Room. Many of these were progressive clinics in the different phases of the various types of appliances used in orthodontics.

Following the clinics there was a business session for unfinished business and installation of officers. The past president's key was presented to Leland T. Daniel by Fred Hale of Raleigh, N. C. Appreciation was expressed to Dr. Daniel and his committees for their contributions.

A total of approximately 250 members and guests attended the meeting.

### Southwestern Society of Orthodontists

If the undivided attention given the speakers is a criterion, the meeting of the Southwestern Society of Orthodontists in Little Rock, Ark., Nov. 1, 2, 3, and 4, 1953, surely was a success. President Clarence Koch and Drs. William R. Alstadt and Thermon B. Smith, together with the assistance of members of the local dental society, saw to it that all of the local details were carefully arranged for the comfort and interests of the visiting orthodontists.

The same favorable comments apply to the other committees. As a consequence, the meeting was orderly and conducted with dispatch.

The guest speakers for the Southwestern Meeting were Dr. Andrew F. Jackson of Philadelphia and Dr. Carl Zeisse, also of Philadelphia.

Dr. Jackson, in a series of four amply illustrated lectures, presented a broad comprehensive consideration of the basic nature of orthodontics as an all-inclusive anatomic, physiologic, and psychologic problem. He set forth the fact that in orthodontics there fortunately are a few simple and logical "principles of treatment" of universal application which are in harmony with Nature's basic laws, which can be applied to each individual case and in which a wide variety of appliances find their logical places of greatest usefulness.

This basic idea was fully amplified and demonstrated by presenting a large and varied number of case reports, showing a wide variety of both fixed and removable appliances. Every lecture was enthusiastically received.

Dr. Zeisse presented lectures on photography in a very live and interesting manner. He gave a historical sketch of those who have contributed so generously toward the simplification and standardization of photography in orthodontics. He also discussed the essential and practical facts one needs to know about lenses, cameras, focusing, guide to exposures for greatest versatility, and at the same time ease and simplicity in use—also the value of the use of photography in cephalometrics. He pointed out that photography is going through a period of transition, and that the goal to be achieved in standardization is the uniformity of technique through which the comparison of photographs in one science with those of another science will have definite scientific value.

Dr. William B. Stevenson, Jr., of Amarillo, Texas, presented a very interesting colored movie on "Removable Appliance—Its Construction and Use."

Dr. Howard H. Dukes of Kansas City, Kan., presented a case report on the "Treatment of Impacted Canines." It comprised the discovery (in desperation) of an attachment to impacted canines after exposure by surgical operations. Its practical use was generally approved.

A number of very practical clinics were given.

The attendance was a little under the usual number, possibly affected by three other orthodontic meetings on the same dates. A proposal was considered for the purpose of coordinating the dates of the several orthodontic organizations to avoid overlapping of meeting dates.

At the luncheon on Monday an impressive ceremony took place in which a properly worded certificate and a beautiful and artistic key was presented to each of the past presidents of the Southwestern Society. In connection with the presentation, a short résumé was made of conditions leading up to the organization and history of the Southwestern Society of Orthodontists, including unusual experiences of its members since its organization. Comment was made of the unusually fine fellowship that has endured throughout the years.

As usual, the golf game, with its pleasure, its feuds, and its accompanying disillusionments, opened the entertainment program. E. F. Woodring and L. C. Trotter tied for low score.

The stag party and the special entertainment for the ladies served as our official welcome to Little Rock.

The chief entertainment feature, of course, was the dinner dance, preceded by a very enjoyable cocktail hour. The Shep Fields Orchestra furnished rhythmic music and an entertaining floor show.

A royal expression to the officers and committees for an excellent meeting was enthusiastically given.

It was considered highly appropriate for Dr. Jackson to be elected to honorary membership.

On arriving at the meeting we were saddened by the report that Dr. J. P. Serafino, Beaumont, Texas, had died a few days before the meeting.

The next meeting of the Southwestern Society will be held in Oklahoma City, Okla., October 10, 11, 12, and 13, 1954, at the Skirvin Hotel.

The newly elected officers are as follows:

President, Marion A. Flesher, Oklahoma City, Okla.

President-elect, William M. Pugh, Wichita, Kansas

Vice-President, Otto L. Voight, Houston, Texas

Secretary-Treasurer, Fred A. Boyd, Abilene, Texas

W. E. F.

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### **Thomas P. Hinman Mid-Winter Clinic**

The next meeting of the Thomas P. Hinman Mid-Winter Clinic will be held March 21, 22, 23, and 24, 1954, at the Municipal Auditorium in Atlanta, Ga.

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### **U. S. Department of Health, Education, and Welfare Children's Bureau, Washington 25, D. C.**

The Nation cannot feel complacent—"that the job of protecting and promoting the health of mothers and children is just about done or at least well on its way," according to a recent statement by Dr. Martha M. Eliot, Chief, Children's Bureau, Department of Health, Education, and Welfare.

Speaking before the Fifty-Second Annual Conference of the Surgeon General of the Public Health Service and the Chief of the Children's Bureau with the State and Territorial Health Officers, Dr. Eliot declared that in the field of maternal and child health we have made "not much more than . . . an excellent beginning. There is an enormous amount of unfinished business that lies before us."

Among specific problems yet to be solved which the Children's Bureau chief cited were:

1. The high cost of prematurity. "The average duration of hospital care in premature centers is about thirty days for the infant and the average cost of hospital care in voluntary short-term hospitals is about \$19.00 a day. . . . Only an occasional hospital insurance plan provides for the newborn period. Undoubtedly, early hospitalization of mothers who have complications of pregnancy . . . does prolong gestation and reduce prematurity, but few states are providing such care." The cause of prematurity is obscure in more than one-half of the births in which it occurs, Dr. Eliot said.

2. Needless loss of infant life. "As impressive as the decline in infant mortality has been, we must keep in mind that 10,000 infants could be saved each year if all counties had rates as low as those with cities of 50,000 population or more. This illustrates again the need for our maintaining a special interest in children in rural areas."

3. Expansion of crippled children's services. The job is one of getting as widespread good service for children with epilepsy, cerebral palsy, and rheumatic fever, as is now being provided for children with orthopedic conditions, Dr. Eliot said.

4. Juvenile delinquency. "To reduce the number of delinquent children will require great extension and improvement in many of our social institutions, and a major change in the economic and social situation in many . . . urban neighborhoods."

5. Mentally retarded children. "Groups in local communities and professional workers are becoming more outspoken about what they want for mentally retarded children and are taking leadership in attempts to get better facilities, training, and treatment programs for these children. The parents need a great deal of help in coping with such a situation."

6. Children of migrant agricultural workers. "One of the major blocks to picking up on this responsibility seems to be a feeling of helplessness in doing it alone. . . . If a group of states could get together, with the state of origin doing its part and the states along the migratory route picking up theirs, through a coordinated plan, all of the states would be helping one another."

Dr. Eliot stated that "state health departments and crippled children's agencies have used their funds with great imagination and insight," and expressed her conviction that "just as we have come this far together, so will we continue this highly satisfactory method of working together and continue to extend and improve services for mothers and children."

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### American Dental Association

The need for greater accuracy in measuring the effectiveness of so-called therapeutic dentifrices (those that will actually prevent dental decay) was stressed Nov. 3, 1953, at a conference in Chicago of twenty-five of the nation's leading dental research scientists.

The conference was called by the American Dental Association's Councils on Research, Dental Health, and Dental Therapeutics in an effort to establish minimum standards and procedures for clinical research in dentistry.

The scientists were sharply critical of incomplete or preliminary research reports which have been and are now being exploited by dentifrice manufacturers as the basis for sensational advertising claims for their products.

In summarizing the findings of the conference, Dr. Harold Hillenbrand, Association secretary, pointed out that the A.D.A. as yet knows of no satisfactory evidence that any dentifrice now on the market will actually prevent tooth decay.

"It is unfortunate that a few dental research scientists have permitted inconclusive or incomplete research reports to be used by commercial interests to mislead the general public into believing that a certain product contains substances that will prevent dental decay," he said.

Dr. Hillenbrand said that many of the misleading and distorted advertising claims now being made for dentifrices containing such substances as chlorophyllin derivatives, antienzyme chemicals, and ammonia-containing compounds were based on inconclusive or inaccurate measurements of their effectiveness.

"It is self-evident," Dr. Hillenbrand said, "that if clinical examinations are to be made a basis for comparing the incidence of dental decay, the examinations must be made with sufficient accuracy to be dependable and reproducible."

The dental scientists participating in the conference agreed that experiments involving the control of dental decay should include the examination of all the teeth of individuals participating in the experiment rather than certain individual teeth or selected surfaces of the teeth.

The scientists also declared that laboratory tests for susceptibility to dental decay should not be used as the sole criteria for determining the ability of therapeutic agents to limit tooth decay.

Dr. Hillenbrand said that many of the claims for the so-called therapeutic dentifrices now being offered to the public were actually based on laboratory findings or on examinations of single teeth or a single tooth surface without regard to the condition of all teeth in the mouth.

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### Northwestern University

On Feb. 22, 23, and 24, 1954, the Graduate Department of Orthodontics of Northwestern University Dental School will present an introductory and refresher course on cephalometric radiography.

The intensive three-day course covers all aspects of cephalometric radiography. The content of the course includes:

1. Normal and abnormal growth of the face.
2. Evaluation of malocclusion and dento-facial disharmony.
3. Evaluation of orthodontic results.
4. Influence of facial growth on orthodontic therapy.
5. Application of cephalometric radiography to functional analysis of occlusion.
6. Normal and abnormal function of the temporomandibular joints.

Instruction in the details and technique of office arrangements of cephalometric equipment, making of the radiographic tracings, and interpretation of the radiographs is given.

A detailed manual, cephalometric radiographs, tracing light, and all other necessary equipment are supplied.

Application for registration should be made to the Dean, Northwestern University Dental School, 311 E. Chicago Ave., Chicago 11, Ill.

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### Notes of Interest

Philip E. Adams, D.M.D., announces the removal of his office to 170 Marlborough St., Boston 16, Mass., practice limited to orthodontics.

John W. Cavanagh, D.D.S., announces the opening of an office for the exclusive practice of orthodontics at 90 Prospect St., Huntington, L. I., N. Y.

Philip L. Klein, D.D.S., announces the removal of his office to the Mid-Valley Medical Bldg., 14140 Ventura Blvd., Sherman Oaks, Calif., practice limited to orthodontics.

Dr. Fred S. Levin announces the reopening of his office for practice limited to orthodontics at 8147 Delmar, St. Louis, Mo.

## OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS is composed of a representative of each one of the component societies of the American Association of Orthodontists.

### American Association of Orthodontists

*President*, James W. Ford - - - - - 55 E. Washington St., Chicago, Ill.  
*President-Elect*, Frederick T. West - - - - - 760 Market St., San Francisco, Calif.  
*Vice-President*, George M. Anderson - - - - - 831 Park Ave., Baltimore, Md.  
*Secretary-Treasurer*, Franklin A. Squires - - - - - Medical Centre, White Plains, N. Y.

### Central Section of the American Association of Orthodontists

*President*, Howard Yost - - - - - Grand Island, Neb.  
*Secretary-Treasurer*, Frederick B. Lehman - - - - - 1126 Merchants Bank Bldg.,  
 Cedar Rapids, Iowa

### Great Lakes Society of Orthodontists

*President*, Louis Braun - - - - - 1601 David Whitney Bldg., Detroit, Mich.  
*Vice-President*, Richard C. Beatty - - - - - Hanna Bldg., Cleveland, Ohio.  
*Secretary*, Hunter I. Miller - - - - - 1416 Mott Foundation Bldg., Flint, Mich.  
*Treasurer*, George S. Harris - - - - - 18520 Grand River Ave., Detroit, Mich.

### Middle Atlantic Society of Orthodontists

*President*, Raymond C. Sheridan - - - - - 59 S. Orange Ave., South Orange, N. J.  
*Secretary-Treasurer*, Gerard A. Devlin - - - - - 49 Bleeker St., Newark, N. J.

### Northeastern Society of Orthodontists

*President*, J. A. Salzmann - - - - - 654 Madison Ave., New York, N. Y.  
*Secretary-Treasurer*, Oscar Jacobson - - - - - 35 W. 81st St., New York, N. Y.

### Pacific Coast Society of Orthodontists

*President*, Arnold E. Stoller - - - - - Medical Dental Bldg., Seattle, Wash.  
*Secretary-Treasurer*, Raymond M. Curtner - - - - - 450 Sutter St., San Francisco, Calif.

### Rocky Mountain Society of Orthodontists

*President*, Don V. Benkendorf - - - - - Metropolitan Bldg., Denver, Colo.  
*Vice-President*, Walter K. Appel - - - - - 4018 Moore Ave., Cheyenne, Wyo.  
*Secretary-Treasurer*, Curtis L. Benight - - - - - 1001 Republic Bldg., Denver, Colo.

### Southern Society of Orthodontists

*President*, Leland T. Daniel - - - - - 407-8 American Bldg., Orlando, Fla.  
*Secretary-Treasurer*, M. D. Edwards - - - - - 132 Adams Ave., Montgomery, Ala.

### Southwestern Society of Orthodontists

*President*, Marion A. Flesher - - - - - Medical Arts Bldg., Oklahoma City, Okla.  
*President-Elect*, William N. Pugh - - - - - Union Natl. Bank Bldg., Wichita, Kan.  
*Vice-President*, Ott Voight - - - - - Medical Arts Bldg., Houston, Texas  
*Secretary-Treasurer*, Fred A. Boyd - - - - - 1502 North Third St., Abilene, Texas

### American Board of Orthodontics

*President*, Raymond L. Webster - - - - - 133 Waterman St., Providence, R. I.  
*Vice-President*, William E. Flesher - - - - - Medical Arts Bldg., Oklahoma City, Okla.  
*Secretary*, C. Edward Martinek - - - - - 661 Fisher Bldg., Detroit, Mich.  
*Treasurer*, Lowrie J. Porter - - - - - 41 East 57th St., New York, N. Y.  
*Director*, Ernest L. Johnson - - - - - 450 Sutter St., San Francisco, Calif.  
*Director*, William R. Humphrey - - - - - Republic Bldg., Denver, Colo.  
*Director*, L. Bodine Higley - - - - - University of Iowa, Iowa City, Iowa

**A List of the Orthodontic Societies of the World and Their Principal Officers\*****Chicago Association of Orthodontists**

*President*, Frederick T. Barich - - - - - 636 Church St., Evanston, Ill.  
*President-Elect*, John R. Thompson - - - - - 55 E. Washington St., Chicago, Ill.  
*Secretary-Treasurer*, Leonard Grimson - - - - - 636 Church St., Evanston, Ill.

**Orthodontic Alumni Society of Columbia University**

*President*, Irving Grenadier - - - - - 888 Grand Concourse, New York, N. Y.  
*Vice-President*, David Dragiff - - - - - 20 East 53rd St., New York, N. Y.  
*Treasurer*, Robert C. Sturtevant - - - - - 88-23 184th St., Jamaica, N. Y.  
*Secretary*, Henry P. Levy - - - - - 8522 5th Ave., Brooklyn, N. Y.

**Harvard Society of Orthodontists**

*President*, Lawrence J. Obrey - - - - - 29 Commonwealth Ave., Boston, Mass.  
*Vice-President*, Bernard C. Rogell - - - - - 6 Pleasant St., Malden, Mass.  
*Secretary*, Ben Wayburn - - - - - 67 Coddington St., Quincy, Mass.  
*Treasurer*, Clifford G. Hunt - - - - - 14 Muzzey St., Lexington, Mass.

**New York Society for the Study of Orthodontics**

*President*, Lawrence Kurland - - - - - 1 East 42nd St., New York, N. Y.  
*Vice-President*, Leon M. Gecker - - - - - 305 West 72nd St., New York, N. Y.  
*Secretary*, A. D. Mollin - - - - - 260 Middleneck Road, Great Neck, Long Island, N. Y.  
*Treasurer*, Irving Lederman - - - - - 45-54 41st St., Long Island City, N. Y.

**New York University Orthodontic Society**

*President*, Adeline S. Guttelman - - - - - 209 E. 23rd St., New York, N. Y.  
*Vice-President*, Abraham Gralnick - - - - - 1 Nevins St., Brooklyn, N. Y.  
*Secretary-Treasurer*, Benjamin Wasseman - - - - -  
*Librarian*, Solomon Lurie - - - - -

**Philadelphia Society of Orthodontists**

*President*, Augustus L. Wright - - - - - 255 S. 17th St., Philadelphia, Pa.  
*President-Elect*, J. M. Jackson - - - - - Medical Arts Bldg., Philadelphia, Pa.  
*Secretary-Treasurer*, John W. Flanagan - - - - - Medical Arts Bldg., Philadelphia, Pa.  
*Librarian*, Richard Stucklen - - - - - 908 Delaware Ave., Wilmington, Del.

**St. Louis Society of Orthodontists**

*President*, Robert E. Hennessy - - - - - 8010 Maryland, St. Louis, Mo.  
*Vice-President*, Leo B. Lundergan - - - - - 4500 Olive St., St. Louis, Mo.  
*Secretary-Treasurer*, Everett W. Bedell - - - - - 1504 S. Grand Blvd., St. Louis, Mo.

**Orthodontic Club of Toronto**

*President*, H. E. Leslie - - - - - 394 Bloor St., W., Toronto, Canada  
*Vice-President*, J. T. Crouch - - - - - 185 St. Clair Ave., W., Toronto, Canada  
*Secretary-Treasurer*, R. D. Leuty - - - - - 317 Rosemary Road, Toronto, Canada

**Washington-Baltimore Society of Orthodontists**

*President*, Donald H. Glew - - - - - 3506 Macomb St., N. W., Washington, D. C.  
*Vice-President*, Paul A. Deems - - - - - 835 Park Ave., Baltimore, Md.  
*Secretary-Treasurer*, George R. Cadman - - - - - 606 Farragut Medical Bldg., 900 17th St., N. W.,  
Washington, D. C.

\*In the January issue of the AMERICAN JOURNAL OF ORTHODONTICS is published each year a list of the orthodontic societies of the world of which the JOURNAL has any record, along with the names and addresses of their principal officers.

The JOURNAL keeps a file for each of these societies and publishes the names that appear in that file as of the date of going to press.

## Foreign Societies

**Sociedad Argentina de Ortodoncia**

<i>President</i> , Raúl Otaño Antier	- - - - -	Jose Maria Moreno 40, Buenos Aires
<i>Vice-President</i> , Ramón Torres	- - - - -	Laprida 1687, Buenos Aires
<i>Secretary</i> , Elio A. De María	- - - - -	Humbertol 2708, Buenos Aires
<i>Assistant Secretary</i> , Alberto O. del Intento	- - - - -	- - - - -
<i>Treasurer</i> , Edmundo G. Locci	- - - - -	Uruguay 763, Buenos Aires
<i>Assistant Treasurer</i> , Eduardo B. Prieto	- - - - -	Tacuari 736, Buenos Aires

**Australian Society of Orthodontists**

<i>President</i> , A. Thornton Taylor	- - - - -	175 Macquarie St., Sydney
<i>Hon. Secretary</i> , Robert Y. Norton	- - - - -	109 Elizabeth St., Sydney
<i>Hon. Treasurer</i> , Robert W. Halliday	- - - - -	131 Macquarie St., Sydney

**Sociedad Brasileira de Ortodoncia**

<i>President</i> , Joaquim Cavalcanti	- - - - -	Praca G. Vargas 2, S. 422, Rio de Janeiro
<i>Vice-President</i> , Kant Duarte	- - - - -	Rua Manuel de Carvalho, 16-9°, S. 91, Rio de Janeiro
<i>Secretary</i> , Virgilio Moozen	- - - - -	de Oliverira, Av. Rio Branco 311-6°, S. 613, Rio de Janeiro

**British Society for the Study of Orthodontics**

<i>President</i> , J. F. Pilbeam	- - - - -	5, Malpas Dr., Pinner, Middlesex
<i>Hon. Treasurer</i> , J. S. Beresford	- - - - -	31 Queen Anne, St., W.1, London
<i>Hon. Secretary</i> , H. Richards	- - - - -	35, Harley St., W.1, London

**Sociedad de Ortodoncia de Chile**

<i>President</i> , Augusto Ramírez V.	- - - - -	Traslavina 230, Vina del Mar
<i>Vice-President</i> , Juan Colin M.	- - - - -	Augustinas 715 of 111, Santiago
<i>Secretary</i> , Sergio Troncoso M.	- - - - -	Providencia 1017, Santiago
<i>Treasurer</i> , Pedro Gandulfo G.	- - - - -	Londres No. 63, Santiago

**Sociedad Colombiana de Ortodoncia**

<i>President</i> , José Mayoral	- - - - -	Carrera 9, No. 21-68, Bogota
<i>Vice-President</i> , Obdulio Mendez	- - - - -	Calle 12, No. 15-06, Bogota
<i>Secretary-Treasurer</i> , Marco Novoa	- - - - -	Calle 11, No. 17-30, Bogota

**Cuban Association of Orthodontists**

<i>President</i> , Dario Gandarias	- - - - -	Calle 25 #954, Vedado, Habana
<i>Vice-President</i> , J. Diaz Zayas-Bazan	- - - - -	Calle 23 #307, Vedado, Habana
<i>Secretary</i> , Luis Santamarina	- - - - -	Edificio L y 23, Vedado, Habana
<i>Treasurer</i> , Federico R. de la Rosa	- - - - -	San Miguel 409, Habana

**Dutch Society for the Study of Orthodontics**

<i>President</i> , J. A. C. Duyzings	- - - - -	Hamburgerstraat 19, Utrecht, Holland
<i>Vice-President</i> , K. G. Bijlstra	- - - - -	Verl. Hereweg 114, Groningen, Holland
<i>Secretary-Treasurer</i> , C. J. Sindram	- - - - -	Kenaupark 27, Haarlem, Holland
<i>Commissars</i> , S. W. Weisfelt	- - - - -	Emmalaan 2, Utrecht, Holland
W. H. S. Sypkens	- - - - -	Hofloan C118, Middelharnis, Holland

**European Orthodontic Society**

<i>President</i> , R. Ernest Rix	- - - - -	35, Harley St., London, W. 1
<i>Vice-Presidents</i> , E. Muzj	- - - - -	Via Parioli, 40 Rome, Italy
E. Fernex	- - - - -	Place du Port 1, Geneva, Switzerland
<i>Hon. Secretary</i> , Norman Gray	- - - - -	16, College Rd., Eastbourne, Sussex, England
<i>Hon. Treasurer</i> , S. E. Wallis	- - - - -	431, Footscray Rd., London, S.E.9, England
<i>Hon. Editor</i> , G. E. M. Hallett	- - - - -	Kings College, Northumberland Rd., Newcastle-upon-Tyne 1, England

**French Society of Dentofacial Orthopedics**

*President*, J. T. Quintéro - - - - - 1, Quai Jules-Courmont, Lyon, 2<sup>e</sup>  
*Vice-President*, A. Leclercq - - - - - 9, Boul. de la Madeleine, Paris, 1<sup>er</sup>  
*Treasurer*, R. Omeyer - - - - - 93, Rue du Commerce, Paris, 15<sup>e</sup>  
*Secretary*, G. Gugny - - - - - 20, Rue Mogador, Paris, 4<sup>e</sup>  
*Assistant Secretary*, B. Beck - - - - - 120, Rue du Maréchal-Joffre, Colombes-Seine

**Guatemalan Association of Orthodontics and Relative Sciences**

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